ENGINEERING NEWS

THE Annual Meeting of the American Society of Civil Engineers occurred at so late a date in the week that we are unable to do much more than give the report of the Board of Direction, and the brief abstract of the proceedings which appears elsewhere. The most important business by far was the discussion on the pending constitutional amendments, and we regret to add that except for the raising of a rather doubtful constitutional point provisions for creating a lower student grade would have been stricken out altogether, leaving only the provisions which materially *raise* the present standard for the grade of Member and Associate Member (or Junior) unchanged, so that there would have been still less tendency than now for engineers to join the Society before they have become qualified for the highest grade.

As it was, the Annual Meeting passed a resolution which almost precisely reversed the resolution passed at the Kaaterskill Convention, in favor of the change. Whether this was due to a real change of views in the membership, or to more careful consideration, or to a permanent difference of feeling among the resident and non-resident membership (which attend in very different proportions at conventions and the Annual Meeting) or merely to the effect of the well timed opposition circular, which was unexpectedly sent out just before the Annual Meeting, will be matter of opinion. We simply state the facts. As respects letters the circular drew out nearly two dozen in opposition, with only two on the other side, one of which was a semi-official response from the chairman of the committee which drew and reported unanimously in favor of the amendments. If its effect in drawing in voters was analogous to its effect in drawing out letters, the reversion of the former vote was not surprising. The amendments go out for ballot, however, substantially as they were drawn, with some amendments as to form, and the general ballot will finally decide—for this year.

THE members of the Am. Soc. C. E., and many guests assembled in the hall of the Y. M.C. A. Building, on 23rd street, on Wednerday evening last, and listened attentively to a paper on the Panama Canal read by Lieut. ROGERS, U. S. N. Lieut. ROGERS was specially detailed by the Government to report upon this work as he found it on the Isthmus in May, 1887; and he was accorded every facility for so doing by the French officials. His paper was well illustrated and was devoted to a detail of the work done, the character of this work, its manner of execution and some of the proposed changes from the original plan made necessary by the scarcity of labor and urgent need for an early opening of the Canal. The paper was followed by a stereopticon exhibit of views along the route of the Canal.

At a reception on Thursday evening, which was a very successful and well attended affair, Lieut. ROGERS declared that he was not an engineer, but was merely stating facts for engineers to draw conclusion from; but he deviated from his own programme in one unfortunate respect, a declaration that while he did not believe a sea-level canal would now be built at Panama, he thought the commerce of the world would demand that one should be built, either at Panama or Nicaragua! The suggestion of a sea-level canal at Nicaragua was perhaps a mere slip of the tongue, but we think few engineers will be disposed to support the view that a sea-level canal is an especially important end at either point, as compared with well designed locks.

Now that Englishmen seem to be "dead set" against a tunnel, as being a possible channel of invasion, the question of bridging the English Channel comes up again: this time from France. *Galignanis, Messenger*, of Jan. 5, sets forth in full the project of Admiral CLOUÉ, formerly French Minister of Marine. In a recent talk with a representative of *Galignani* the Admiral reviewed the various schemes proposed for a Channel bridge, from that of MATHIEU, in 1802, to the latest. He had no faith in a suspension bridge, "which the first nor-wester would blow from its moorings," but wants to put down a massive iron superstructure on stone piers. It would start at Ambleteuse and end at Folkstone, a distance of 35 kilos, or 21.7 miles. It would have two angles in it to take advantage of certain reefs. The depth of water on the line varies from 40 ft. to 164 ft. He would build, of concrete and masonry, piers 164 by 108 ft., which would rise about 33 ft. above the surface and there support lofty iron towers to carry the superstructure. He proposes spans of 1,600 to 2,000 ft. This enormous span is to be built at the shore on four pontoons; towed to the site and then let down on the masonry by sinking the pontoons somewhat by letting water into them, and finally hoisting the span to position by hydraulic power, building the tower under it as it goes up. The bridge would be 30 m. (98.4 ft.) wide and accommodate 4 railway lines and a road for vehicles, etc, The headroom under the bridge is to be 164 to 200 ft. The Admiral thinks that as bridges 2 miles long have been built, one of 20 or more miles is simply a question of money invested. As to the foundations, he refers to the work now being done at Hawkesbury in New South Wales by Americans. To meet English objections he proposes to put a draw at each end, which should allay all fear of invasion. It is said that "The Channel Bridge and Railway Co. is organized to carry out the scheme, with M. HERSENT to engineer the foundations, and Messrs. FOWLER and BAKER as Consulting Engineers. The ironwork is to be done by the Creuzot Co." All of which we give for what it is worth.

CHAS. H. FISHER, for many years Chief Engineer of the New York Central & Hudson River Railroad, died on Wednesday last, after a lingering illness of several years, which has made life a burden to him. He was born in 1835, and had a distinguished professional career.

A BILL has been introduced into the New York legislature, prepared in accordance with the resolutions of the Rochester Canal Convention, proposing to improve navigation on the Erie and other State canals. The locks are to be made 220 by 18 ft. and the general depth of the canal increased from 7 ft. to 9 ft. This improvement would permit from 1,500 to 2,000 bushels of grain to be carried in excess of present loads, and steam could be substituted for mules. The advocates of the bill claim that as a steam vessel, carrying 6,500 bushels, could tow three other boats carrying 32,000 bushels, the carrying capacity would be increased about one quarter, and the rate could be reduced from an average of 4½ cts. to 3½ cts. As the canals carried 45,000,000 bushels last year, the saving in freight would pay for the improvement in a few years. The rate on coal and other heavy freight would also be reduced and there would be no tug-hire between Albany and New York An appropriation of $1,000,000 is asked for to start with, and the estimated total cost is about $5,000,000.

AT the last meeting of the Aqueduct Commission the statement was made that the following contracts and specifications are now ready for consideration: For the second dam at the East Branch Reservoir and the preparation of the basins of the reservoirs for the storage of water, the construction of the principal dam having already been contracted for and work commenced; for the Muscoot Dam and reservoir; for the pipe line from the gate house at One Hundred and Thirty-fifth-street and Convent avenue to the Central Park Reservoir; for the new gate house on the northerly side of the Central Park Reservoir for the reception of water from the new aqueduct. The work not yet ready includes the Quaker Bridge Dam and Reservoir and a storage and distributing reservoir in the northern part of the city near Jerome Park.

WE are glad to note that the casting of the first steel gun by the Pittsburg Steel Co. has so far been successful. Some days will yet elapse before the result can be fully tested but all indications are very promising. The gun is to be a 6-in. breech-loader, of cast-steel, and the initial velocity expected when finished is 2,000 ft. per second with 15 tons pressure in the breech chamber. The material used by the Pittsburg company is Bessemer steel; and as the test prescribed for the 6-in. built-up guns, with which it is to compete, are not deemed severe by the steel men, the success of this new gun would mean a most radical departure in gun making, and cheaper and more rapidly made guns for our country just when it needs them most.

THE Brooklyn elevated road, which has not been a very brillant financial success heretofore, increased its earnings last year 30 per cent., against only 4 per cent. increase in expenses, and has at last begun to pay. It carried last year 12,172,353 passengers, an increase of 2,013,688, operating 6.75 miles. But this is a small traffic indeed compared with the present rate of nearly 200,000,000 on the four New York lines. The fixed charges are $9,171 per mile. Three new lines are to be opened shortly, two of which at least are quite sure to have a larger traffic than the existing line. As soon as they are opened, the necessity for very great and speedy enlargement of the Brooklyn bridge transporting capacity will be still more apparent than it is now.

THE Albuquerque Land and Water Co. proposes to reclaim 1,500,000 acres of land by building an irrigation canal 142 miles long in New Mexico. The canal would be 30 ft. wide at top, 18 ft. on the bottom and 6 ft. deep. It is to run through Rioaroaba, Santa Fè, Valencia, Bernalillo and Socorro counties on the mesa and bottom lands of the Rio Grande valley. The water supply comes from the Rio Grande river. It is stated that work is to commence in 10 days.

ACCORDING to late Detroit reports the tunnel under the St. Clair river at Port Huron has not been abandoned. As the work stands, shafts have been sunk on each side of the river, and a trial tunnel 6 ft. in diameter has been driven under the water for some distance. This work was done by the firm of SOOYSMITH & Co., of New York, but last summer a gas-pocket was struck, and the trial tunnel was discontinued. The firm mentioned, however, concluded that the tunnel had been carried far enough to uncover the full extent of the obstacles to be overcome, and it made a bid to the Grand Trunk Co. for the completion of a full sized tunnel. The report mentioned, now says that the railway company thinks its own engineers have now acquired a full knowledge of the situation, and that the work can be more cheaply done by day's labor than by contract. It is evident that the task encountered at Port Huron is no easy one, and it would doubtless be the wiser course to entrust its execution to experts rather than to the inexperienced. Otherwise the tunnel may be found too expensive to be profitable, and be abandoned as was the one at Detroit.

THE combination set-square of Mr. W. H. DASHWOOD—CAPEL, referred to lately, is like an ordinary triangular square in appearance, excepting that the angle made by the intersection of the hypothenuse and the base is 45°, and the angle with the perpendicular is 60°; the lines intersecting about the middle of that side of the triangle. The advantages are that it combines two tools in one, and avoids the sharp lower angle of the usual 60° triangle.

THE Strong Locomotive Works, of New York, are said to be negotiating for building locomotive works at Sparrow's Point, near Baltimore, in the vicinity of the furnaces being erected by the Pennsylvania Steel Co. We rejoice to learn that that interesting new type of engine has made its way enough to require even the consideration of the erection of new works.

THE evils of facing point switches were again illustrated this week on the elevated, by a derailment of otherwise trifling importance. A light engine was switching on to another track, and the leading wheels passed the points in safety, when the latter became displaced, and let the rear wheels down on the ties. The delay was only for a few minutes, and only in the case of the New York elevated are such little events made matter of record at all, or the largest newspaper would contain little else, but they show clearly that with very heavy passenger traffic, facing switches are entirely out of place if possibly avoidable.

MEETING OF HEADINGS ON THE NEW CROTON AQUEDUCT.

(OFFICIAL RETURN.)

Order of Meet'g	Headings.	Date of Meeting	Error in line. Feet.	Error grade. Feet.	Distance between shafts. Ft.	Depth of Shafts. Feet.
4	By Pass and Shaft 0.	Sept. 1, 1886.	0.005	0.010	.....	.....
9	Shafts 0 S. and 1 N.	Oct. 15, 1886.	0.09	0.108	4547.4	.....
37	1 S. and 2 N.	Nov. 19, 1887.	0.09	0.014	6399.5	333.38
36	2 S. and 3 N.	Nov. 1, 1887.	0.05	0.038	6199.4	349.30
35	3 S. and 4 N.	Oct. 8, 1887.	0.27	0.025	6599.9	350.02
34	4 S. and 5 N.	Sept. 16, 1887.	0.71	0.019	6599.6	246.50
24	5 S. and 6 N.	July 13, 1887.	0.33	0.018	6498.4	108.62
18	6 S. and 7 N.	April 27, 1887.	0.90	0.035	6098.7	178.59
7	7 S. and Open Cut 8.	Nov. 5, 1886.	0.075	0.024	1806.0	161.84
38	8 A. and Open Cut 8.	Dec. 21, 1887.	0.000	0.000	251.0	.....
5	Open Cut 8 and 9 N.	Sept. 3, 1886.	0.012	0.000	1727.0	.....
16	9 S. and 10 N.	Feb. 25, 1887.	0.229	0.010	6444.9	.....
19	10 S. and 11 A. N.	May 10, 1887.	0.464	0.010	7580.0	125.55
30	11 A. S. and 11 B. N.	Aug. 16, 1887.	0.022	0.004	1169.0	31.17
25	11 B. S. and 12 A. N.	July 15, 1887.	0.010	0.010	7568.0	34.71
13	12 A. S. and 12 C. N.	Dec. 13, 1886.	0.003	0.006	382.0	41.88
23	12 C. S. and Portal 12 N.	July 6, 1887.	0.000	0.014	422.0	.....
8	Portal 12 S. and 12 B. N.	Oct. 11, 1886.	0.030	0.027	164.8	.....
6	12 B. S. and 18 N.	Sept. 11, 1886.	0.021	0.009	3791.6	38.60
	13 S. and 13 A. N.	Not finished. On Jan. 1, 1888, 72 ft. still to run.			614.4	154.43
	13 A. S. and 13½ N.	Not finished. On Jan. 1, 1888, 450 ft. still to run.			1254.0	156.00
	13½ S. and 14 N.	Not finished. On Jan. 1, 1888, 1,124 ft. still to run.			3299.9	124.00
1	14 S. and Open Cut 14.	Nov. 16, 1885.	0.00	0.00	55.8	28.22
26	14 A. S. and 15 N.	July 22, 1887.	0.00	0.003	5986.2	.....
27	15 S. and 16 N.	July 29, 1887.	0.80	0.027	7850.9	126.58
17	16 S. and 17 N.	March 8, 1887.	0.30	0.050	7099.9	72.22
....	17 S. and 18 N.	Not finished. On Jan. 1, 1888, 262 ft. still to run.			7232.0	59.67
2	18 S. and 18½ N.	June 8, 1886.	0.042	0.010	1284.0	.....
21	18½ S. and 19 N.	May 26, 1887.	0.010	0.021	6032.0	47.00
20	19 S. and 19½ N.	May 13, 1887.	0.016	0.019	3534.0	67.76
14	19½ S. and 20 N.	Feb. 5, 1887.	0.000	0.016	3116.0	35.00
12	20 S. and 21 N.	Dec. 12, 1886.	0.025	0.034	5425.0	115.36
31	21 S. and 22 N.	Aug. 18, 1887.	0.016	0.030	6926.0	101.69
3	22 S. and 23 N.	June 22, 1886.	0.114	0.105	3940.0	80.59
11	23 S. and 24 N.	Nov. 12, 1886.	0.021	0.080	4289.0	64.69
....	24 S. and 25 N.	Not finished. On Jan. 1, 1888, 720 ft. still to run.			1312.0	176.00
10	25 S. and 26 N.	Oct. 30, 1886.	0.01	0.005	518.0	268.00
22	26 S. and 27 N.	June 29, 1887.	0.01	0.002	977.0	115.00
....	27 S. and 28 N.	Not finished. On Jan. 1, 1888, 54 ft. still to run.			2730.0	147.70
32	28 S. and 29 N.	Sept. 10, 1887.	0.09	0.021	2364.0	122.70
29	29 S. and 30 N.	Aug. 11, 1887.	0.04	0.011	2203.0	113.60
28	30 S. and 31 N.	Aug. 5, 1887.	0.02	0.002	2159.0	79.80
15	31 S. and 32 N.	Feb. 22, 1877.	0.07	0.001	1448.0	78.20
33	32 S. and Gate House.	Sept. 12, 1887.	0.00	0.00	194.0	86.00

Meeting of the Headings on the New Croton Aqueduct.

The table given herewith is the official return to Chief Engineer B. S. CHURCH, showing the degree of accuracy with which the lines and levels have met so far, on this 30-mile tunnel. Out of the 38 headings already "holed" and checked, there are some few rather wide of the mark, when tested by the standard of accuracy set by the engineers themselves, for the great bulk of this work. But in each of these cases of divergence from the true alignment, the distances between shafts was considerably over a mile, and the shafts themselves were usually of the deepest on this line.

While it might be said that absolute accuracy in the meeting of lines is rather a matter of professional pride in the engineer-in-charge than one of structural or working necessity, especially in a water-works' tunnel, the general record as here given, is very worthy of note. If we first deduct the six records which exceed a divergence of 3 ins. from the true line, we find that the average for these six is about 7 ins. But for the remaining 32 "m eetings" the average divergence is a little less than ¼ in., or 0.037 ft. The levels check inside of 0.035 ft. as the maximum, and a very few of them come anywhere near even that small divergence from the true plane.

The table taken as a whole, speaks very well for the great care taken in originally establishing the line on the ground, and for the further care in transferring this line down deep shafts and for one-half mile or more either way underground.

As a matter of interest in this connection and as showing what can be done with elaborate instruments and extreme care we may state that the record ofthe meet ing of headings in the Hoosac tunnel, in 1872, still stands uneclipsed, so far as we know. Mr. EDWARD S. PHILBRICK, of Boston, was the State Consulting Engineer of the tunnel at this time, and Mr. BENJ. D. FROST the resident Chief Engineer. He had two large transits made with 2-in. achromatic objectives and astronomical eye-pieces, with the transits hung on a double cone horizontal axis only.

Much time was spent in adjusting and verifying the outside line, and this was then transferred down the center shaft, which was 1,030 ft. deep and encumbered by 64 floors. The usual two-plummet method of transfer was used with many refinements of detail called for by the peculiar conditions. The headings between the east end and the central shaft met on Dec. 12, 1872, at a point 1,563 ft. from the shaft and 11,274 ft. from the east portal; the error in alignment was $\frac{5}{16}$-in.; and in levels, "a few hundredths of a foot." The headings from the west end met on Nov. 27, of the same year, at a point 10,138 ft. from the portal and 2,056 ft. from the shaft; the error in alignment here was $\frac{5}{16}$-in. and in levels, 0.134 ft. This is a remarkable record of instrumental work. M. GENESI, in describing the Mt. Cenis tunnel says that, "The two axes met almost exactly; there was barely half a yard error." "The level on one side was only 60 centimetres (23.4 ins.) too high." As the length of the headings in this tunnel (opened in 1871) averaged 20,000 ft., the record of accuracy at the Hoosac and at Mt. Cenis compare about as 1 to 10.

Snow-Sheds on the Canadian Pacific Ry.

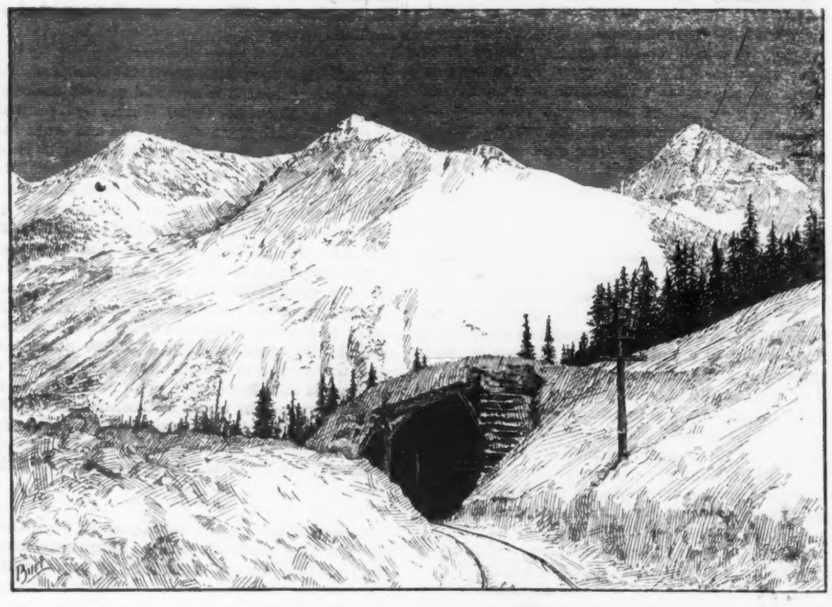
We are indebted to Mr. C. A. STOESS, Resident Engineer of the Pacific Division, C. P. Ry., for the followi..g description of the later snow-sheds erected on this route:

During the season of 1886 about 4 miles of sheds in all were built to protect the line against snow slides. The design most extensively adopted is that of a crib built up to full height on the upper side of the track (see Fig. 8) with the space between the crib and the hill filled in with earth as shown. On the lower side was a frame work of 12×12 in. timbers, resting on sills or piles as the conditions required. The crib was made of 12×12 in. timbers, squared on the face and round at the back, with 3 in. spaces between courses. The ties were dove-tailed to the front timbers and saddled, or let in with a square joint, at the back. The bents in all cases were 5 ft. between centers, with the ties in the cribwork breaking joints every 10 ft., with packing pieces between.

The entire timber-work in the sheds was drift-bolted together; no mortices or tenons were anywhere used, but dowels were used in the foot of posts, etc. The joint at the meeting of the stringer, plumb post and batter post was made as shown in Fig. 7. But the experience of the winter of 1886-87 showed that the space left out of the planking, for daylight, marked *a*, was too great, and the joint shown in the several views given was adopted, though it is somewhat weaker.

In 1886 some level sheds in through cuts were built with the sides sloping down somewhat; some had small cribs to resist the impact of the snow slides.

The figures here given show the sheds built in 1887. The timber used in the cribs was cedar exclusively, and the front logs were 10×12 in. and the back logs were "flatted" in order to obtain a dove-tail joint at both ends of the ties; the ties were round as before. The length of shedding built in the season of 1887 amounted to about 2 miles, inclusive of about 1,500 ft. for level snowfall. Hence the total of snow sheds on the line is now 6 miles and 300 ft. The sheds protecting the track against snow slides cost from $2,500 to $7,000 per 100 lin. ft. of shed, according to location. The sheds for level fall cost from $800 to $1,000 per 100 lin. ft., or we can put the price at from $25 to $70 per lin. ft. for the first type, and from $8 to $10 per lin. ft. for the second.

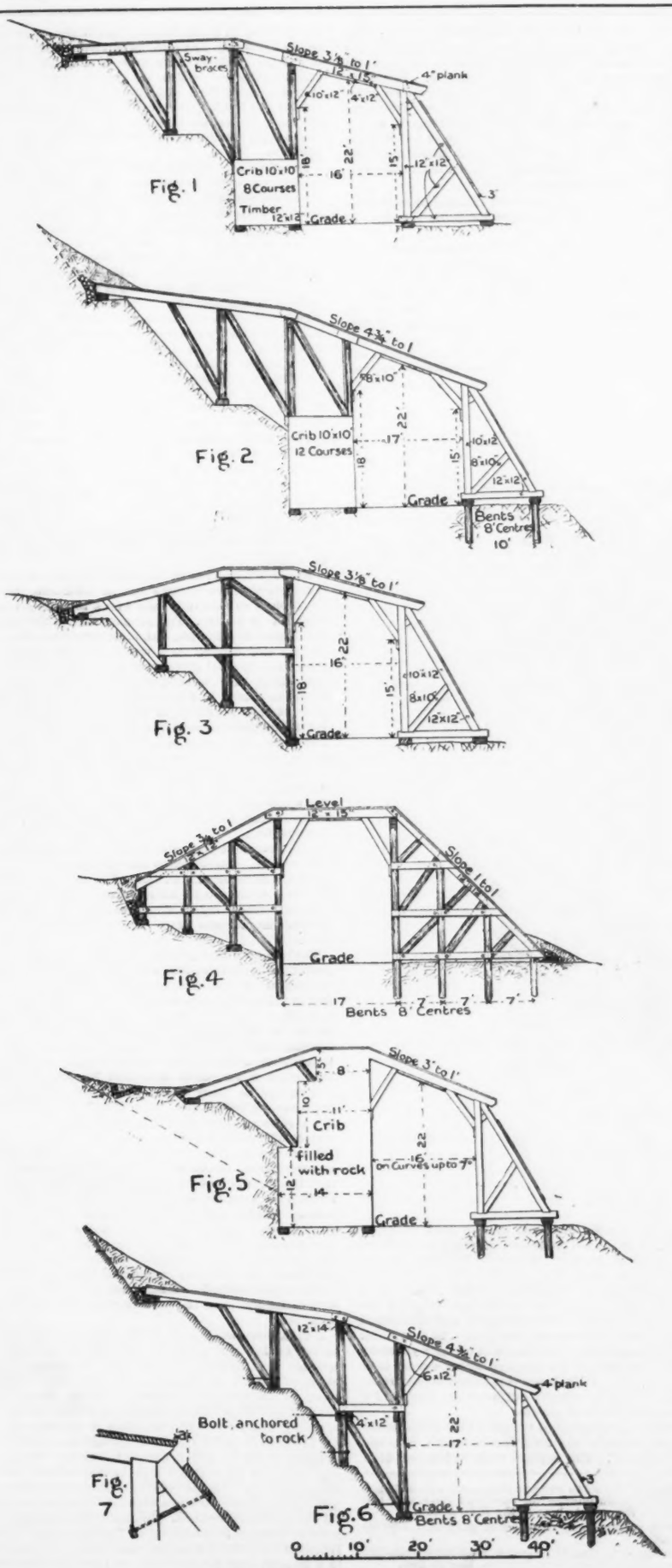


Entrance to Snow-Shed; C. P. Ry.

As built in 1887 the bents of the timber work were 5 ft. and 8 ft. centers, the design being to have a crib which would act as a retaining wall and support a framed structure above it. The struts and toe-braces were drift bolted at the ends and supported by a claet, as particularly shown in Fig. 6, where the strut butted against a post or pile.

The weight of the snow-slide material, or compressed snow, varies from 25 to 45 lbs. per cu. ft., and this is generally discharged in balls, from the size of a man's head upward, according to the state of the weather and whether the mass is wet or dry. Dry snow comes down with a great velocity and strikes a very hard blow against the structure; while wet snow descends more slowly.

Fig. 10 shows a strutted glance-fence, planked on



Snow-Sheds: Canadian Pacific Railway.

the face, used to save length of snow-shed by diverting the slide into gullies. Split fences of a V form with the point towards the slide, have been built and so far have answered very well. In this latter fence the chief requisite is to present a sharp angle to the slide and back this point with a very strong and heavy crib.

In answer to a question, Mr. STOESS said that in no case have they had trouble from fire in these sheds, though in summer the timber is very dry. As a precaution pipe lines have been laid to the important sheds, with hydrant nozzles every 400 ft. and a coil of 200 ft. of hose at each nozzle. But so far they have had little occasion to use these appliances, and the experience on the Austrian railroads, likewise provided with many timber snow-sheds, proves that immunity from fire is not singular to the C. P. Ry.

Asphalt Pavements.

A street pavement is, strictly speaking, an engineering construction, designed to carry certain loads, and resist wear from blows and abrasion. The same materials are available for this as for any other form of construction, viz., stone, wood, iron, and brick; and the only questions for consideration are first, which of these materials is best suited to the requirements of this special kind of construction; and second, having decided the material, what is the best form in which to use it.

In considering the kind of material, iron and brick are eliminated almost at the start. Even the hardest bricks are brittle and friable; their edges are soon broken by the blows of the horses feet and the grinding of heavy wheels. Brick roadway pavement was tried in Washington, along with nearly every other form of street experiment that human ingenuity could devise, in 1874; it proved a total failure, and after a few years was taken up and replaced by asphalt. It has since been tried in some small towns in the Ohio valley, but it is not suited to the traffic of larger cities.

Iron is of course eminently durable, but it is a failure as a pavement from wholly different causes. It is so slippery that horses cannot gain a foothold on it. About thirty years ago Cortlandt street in New York was paved with an iron pavement; in order to guard against slipperiness the surface was made very rough, and consisted of hexagonal projections about an inch in size, separated by depressions of about the same size. It was both rough and noisy, the horses caught their calks in the depressions and twisted off their shoes, and in spite of its roughness the horses fell frequently, and with disastrous results in tearing their knees on the sharp projections. It remained in use but a comparatively short time and was then replaced with stone.

Wood as a paving material has been widely used in the United States during the last twenty-five years, and in Europe during the last ten years. It has great advantages in its smooth and noiseless surface, and equally great disadvantages in its lack of resistance to wear and its tendency to decay. It has been used in two different forms, and with very different results; in America in the form of round blocks, on sand, with or without an intermediate layer of plank; in Europe, in rectangular blocks on a solid foundation of concrete. The round cedar blocks are much used in the Lake cities near the great forests of the northwest. They are very cheap, almost as cheap as dirt, and after a few years not much better as a road covering. Under ordinary traffic for about three years they remain in good order, the fourth year holes begin to appear, the fifth year holes are very numerous, and after the sixth or seventh year they are a mass of decaying rubbish.

The wood pavements of London and Paris have a solid foundation of concrete, but their wooden superstructure lasts on an average only from four to six years and is then replaced. Under the Paris contracts* the contractor is required to maintain the pavement for eighteen years, and his payment is 89 cents per yard per year, or $16.02 for the full term. He is expected to relay the wooden surface every six years on streets of moderate traffic and every four years on streets of heavy traffic.† The first London contracts were on the same basis, but lately the Vestries have adopted the plan of doing the work by day's labor. They lay fresh wood on the concrete once in about five years and the first cost and renewals during eighteen years amount to about $9 per yard. Undoubtedly at such a price agreeable and satisfactory pavements of wood can be had, but the same results can be obtained with other materials for about two-thirds the cost. Samples of wooden pavement, similar to those in London and Paris, have been laid on Fifth Avenue between 32nd and 33rd streets and on Beaver street in front of the Produce Exchange.

Stone is the oldest of paving materials, and has al-

*Contract of May 19, 1883.
†Letter of M. Allard, Engineer-in-Chief of Paris May 5, 1884.

ways been and is now the most widely used, and in a great variety of forms. The old Roman roads were paved with blocks of hard stone about a foot square and 8 ins. deep. Broadway in New York was once similarly paved, and a survival of this ancient form may still be seen in Whitehall street near the Battery, and in some streets in New Orleans. Its obvious disadvantage are its slipperiness, for the stone surface proper is next to iron the most slippery of all paving materials; it is only the joints which afford a foothold, and to be effective these must be separated from each other by less than the length of a horse's shoe.

Round cobble stones—beach shingle—was the next form of stone block. This possessed the merits of cheapness and affording a good foothold, and the demerits of roughness and noise. Being laid on sand, and the stones being of irregular shape it is almost impossible to form a bond, or hold them in place. When the frost leaves the ground in the spring, one stone is forced down by the weight of the wagon and another is spewed up, until soon the roadway is a mass of loose rocks. Philadelphia enjoys the preeminence of being the only city to retain this pavement on a large scale at the present day. It has about 530 miles of it, and it spends every year about $200,000 in trying to keep it in order, without any success. St. Petersburg has the best specimen of cobble pavement. The stones are remarkably uniform in size, about 7 ins. long, and 3 ins. thick. They are set on end, or on their points, and having so much more depth than width they wedge together, and form a comparatively durable surface.

The next form of stone blocks was the small cubes, about 5 ins. on the side, of hard trap. This was first laid in Brussels, thence imported to Paris, and from there to America, where it became widely known as the Belgian pavement. More than half of the streets of New York are paved with it. The stones being of regular shape remained in place better than cobble stones, but the cubical form was a mistake as it afforded too many longitudinal joints, which wore into ruts under traffic. This led to the final step in stone block pavements, which was to lengthen the blocks, thereby diminishing by fully one-half the number of longitudinal joints, and to make the blocks of granite instead of trap, as the former stone does not polish under traffic and is less slippery than the latter. The oblong granite blocks on a foundation of concrete and with a bituminous waterproof filling in the joints, is the latest type of stone block pavements. Broadway was thus paved nearly twenty years ago and the pavement is still in use, although now *much* in need of repairs. Fifth avenue has just been similarly paved. The best specimens of such work are in the English cities of the second size, Liverpool, Manchester and Birmingham—their superiority consisting in the uniform size and shape of the blocks.

Such pavements are the most durable known; they are also among the most costly,* and the very best of them are rough and noisy.

In the form of macadam, with or without the Telford foundation of large stones, stone has been used as a road covering in Europe and America for nearly a century. London has 573 miles of streets paved with it, and Paris about as much.† The size of stone is usually not to exceed 2½ ins., with a top dressing thoroughly rolled in, of stone not exceeding ½ in. in size, all of the hardest stone procurable. This pavement has the advantage of smoothness and a good foothold; its disadvantages are its dirtiness and its cost of maintenance. The stones are bound together or cemented solely by small particles of stone. If these are removed the top layer of stone becomes loose and is kicked about by every passing horse; if they remain, they always constitute a thin layer of dust or mud. Its first cost is comparatively small, its maintenance, if kept in proper order under city traffic, is enormous. Parliament street in London costs 58 cts. per yd. every year, and the Avenue des Champs Elysees more than $1.00 per yd. per year.** It was this unbearable expense which led to the substitution of wood on concrete for macadam on both these streets.

The final use of stone, and the one which presents the greatest advantages and least disadvantages, is in the form of asphalt. The asphalt rock which has been largely used in Paris, London and Berlin, is an amorphous limestone, naturally impregnated with bitumen, of which it yields on analysis about 10%. The Trinidad asphalt pavement which has been so largely used in Washington, Buffalo and other American cities, is a mixture of sand, powdered limestone and bitumen, forming an artificial sandstone, impregnated with bitumen, of which it yields about the same amount on analysis.

The mines of asphalt rock in the Val de Travers, Canton Neuchatel, Switzerland, were discovered in 1721, but it was not until 1849 that its utility as a road covering was noticed. The rock was then being mined for the purpose of extracting the bitumen contained in it, for use in medicine and the arts. It was observed that the pieces of rock which fell from the wagon were crushed by the wheels, and under the combined influence of the traffic and the heat of the sun a good road surface was produced. A macadam road of asphalt rock was then made and gave very good results, and finally, in 1854, a portion of the Rue Bergere, in Paris, was laid in compressed asphalt on a concrete foundation. In 1858 a still larger sample was laid and from that time it has been laid year by year in Paris until now about 20 miles of streets are paved with it. From Paris it extended to London, being laid on Threadneedle street, in 1869, and Cheapside, in 1870, and in successive years on other streets to the extent of about 15 miles. It has also been extensively used in Berlin and other cities on the continent. And it is a fact worthy of notice that while both granite and wooden pavements have in many instance been removed and asphalt substituted in their place, in not one instance in London, Paris, or Berlin has an asphalt pavement been taken up in order to lay another kind of pavement in its stead.

The foundation for all these pavements was a bed of solid concrete from 6 to 8 ins. in thickness. On this the asphalt surface was laid with a thickness varying from 1¼ to 2½ ins. The preparation of the asphalt was simple in principle, although requiring some care. The natural asphalt rock was broken into pieces less than 2 ins. in size; these were placed in a disintegrator, where they were crushed to a fine powder; this was then heated to a temperature of about 280° Fahr. and taken to the street in carts; while still hot it was spread on the concrete in a layer of proper thickness, and then compressed and consolidated by the blows of a hot tamping iron or rammer. Care was taken not to heat the material to a temperature that would fuse the asphalt, and cause the mass to become fluid or viscous, the whole object of the preparation being to get a layer of the asphalt rock, exactly in its natural state, on the concrete bed.

This pavement possessed all the desired qualities of smoothness, noiselessness and cleanliness: its only fault was its slipperiness, due to the extremely minute particles of limestone which formed the body of the rock, and under traffic became almost as smooth as polished marble and gave the horses but slight foothold.

The success of asphalt pavements in Europe led American inventors to seek to manufacture a material which should have similar qualities, and the first idea was to utilize the tar produced at gas works which then was almost without value. The result was about twelve to fifteen different compounds, varying only in details, and all essentially composed of sand and tar forming an artificial sandstone. Large quantities of this class of pavement were laid in Washington in 1871-'74, and in other cities, the stone pavement on Fifth avenue being thus "poulticed" over its surface. A few of these pavements, in which a portion of asphalt was combined with the tar, were moderately successful, but the greater portion of them failed completely and were soon ground into black dust. The reason was that the tar did not have proper cementing qualities and did not hold the sand together. The tar contained certain volatile oils which evaporated under the hot sun, and the "sticky" or cementing quality was gone. Another defect—secondary in importance to the lack of durability but still very objectionable—arose from the fact that the tar was very sensitive to heat, and while so hard as to be brittle in winter it was so soft that wheels of vehicles and even the heels of shoes sank into it in summer.

Among those who sought to discover an artificial material having the excellent qualities of the natural asphalt was EDWARD J. DESMEDT, a student of the chemical school of Brussels, who had made a careful study of the asphalt pavements of Paris. He came to the United States in 1861, and about 1870 he turned his attention specially to the question of pavements. In his investigations he rigidly discarded the use of any products of tar on account of their volatile character, and sought a bituminous cement that should not be affected by heat. The so-called Albertite and Grahamite and other natural bitumens found in this country were tried, but without success. He finally discovered in the natural bitumen of the so-called "asphalt lake" in the Island of Trinidad a material which had been exposed to a tropical sun for centuries, so that the sun's heat

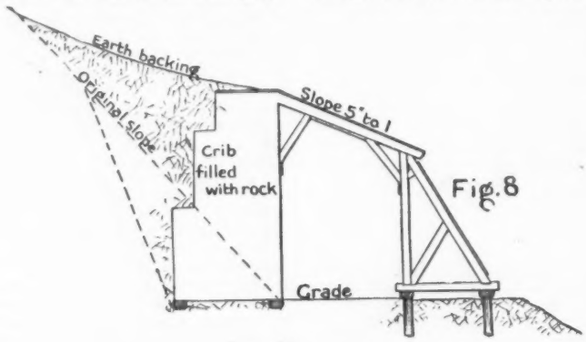


Fig. 8

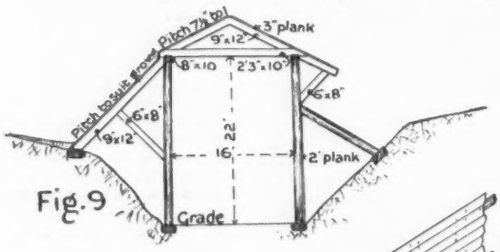


Fig. 9

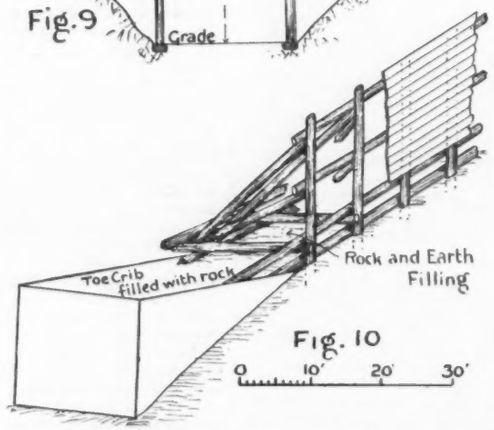


Fig. 10

Snow-Sheds and Glance Fence; C. P. R.

*The cost of the Fifth avenue pavement was $4.60 per sq. yd., with maintenance for one year only, and the old stone on the street given to the contractors.

†For the maintenance of which it pays over $900,000 per annum.

**From paper by GEO. H. STAYTON, read before the Institution of Civil Engineers, London, May 27, 1884.

had exhausted its effect upon it. By combining this with certain products of petroleum, from which all volatile matters had been expelled in the process of refining at a very high temperature, he finally succeeded in making a thoroughly satisfactory bituminous cement Mixing this in proper proportions, determined by actual experiments, with sharp, silicious sand, and a small quantity of powdered limestone, he made a pavement which had all the durability, smoothness, cleanliness, and freedom of noise, of the natural asphalt rock, and at the same time was much less slippery, as its body was composed of sharp sand instead of fine limestone. He had in short made the desired bituminous sandstone.

As sand is found in the vicinity of every city, this artificial product had a great advantage in cost over the natural rock which had to be transported 5,000 miles by land and ocean from the mountains of Switzerland.

Small samples were laid in Newark and New York in 1870 and 1873, but it was not until 1876 that the pavement was laid on a large scale. In that year Pennsylvania avenue in Washington was in an almost impassable condition, being covered with the rotten remains of a wooden pavement. Congress directed its repaving and appointed a commission consisting of Generals H. G. WRIGHT and Q. A. GILLMORE of the Corps of Engineers and Mr. EDWARD CLARK the Architect of the Capitol, to have supervision of the work. The terms of the law directed them to lay the "best pavement." They advertised for proposals, making no restrictions as to materials. They received 41 proposals, for every variety of stone, wood, macadam, tar, and asphalt. Out of them all the commission selected two, and laid these respectively on ⅔ and ⅓ of the avenue. These were the natural rock asphalt of Neuchatel, and the Trinidad asphalt mixture of De Smedt. Both pavements were completed in the spring of 1877, and are to day in excellent condition with but trifling repairs after eleven years of traffic.

In 1878 the present permanent form of government by three Commissioners was established for Washington. One of these Commissioners was to be an officer of the Engineer Corps of the Army, whose special duty was to supervise the public works of the city. Major W. J. TWINING was appointed to this office and served in it until his death in 1882.

Washington had then nearly 50 miles of wooden pavements, laid at a cost of over $4,000,000, which still constitutes a large part of its debt. These pavements were barely five years old, but nearly all of them had decayed to such an extent that they were nearly impassable. In certain portions of the city for more than a mile in any direction it was impossible for a vehicle to proceed faster than at a walk without breaking down. The placing of the streets again in a state of viability was the first and most serious problem presented to Major TWINING. He studied the subject thoroughly and fundamentally, and finally decided to adopt the asphalt as the standard pavement, reserving the granite blocks for those localities where special conditions of traffic or grade made the asphalt undesirable. He distinctly rejected the Neuchatel or rock asphalt as being too slippery, and the tar pavements as lacking in durability; and following the line indicated by the commission of 1876, he selected the Trinidad asphalt mixture as giving the most satisfactory results. The experience of the last ten years has amply vindicated his judgment. Washington is to day universally known as the best paved city in America, if not in the world. Its 70 miles of smooth and durable asphalt afford roadways which for comfort, convenience, and economy of hauling, are not rivalled elsewhere.

A large portion of the asphalt pavements of Washington were laid by the firm of A. L. BARBER & Co., and in the spring of 1883 this firm was incorporated as the Barber Asphalt Paving Company, which began the introduction of the Washington asphalt in other cities. Buffalo and Omaha were the first cities to try it, and in these the asphalt has now reached a development of nearly 1,000,000 yards or about 65 miles. From these it has spread to various cities, 16 in all, in which the total area is now a little over 3,500,000 yards, or 225 miles. This is more than three times the area of all the rock asphalt pavements in the world. It has been laid in the space of twelve years, whereas the rock asphalt industry is more than thirty years old. Two-thirds of all the Trinidad asphalt pavements have been laid by the Barber Asphalt Paving Company.

These results could not have been accomplished unless the pavement had unusual merit, and the obligations of the company had always been carried out to the letter.

Its merit consists in its smooth and uniform surface which reduces the force of traction and thereby effects an economy in transportation, and at the same time adds to the comfort of every person who rides in a carriage—in its cleanliness, containing no joints to collect street filth and give it off in dust, and no vegetable matters to decay and poison the air with noxious vapors—in its noiselessness, which relieves the racket and roar of great cities, so trying to the nerves. These excellent qualities are not denied by any one. Two defects have been alleged against it, first that it is slippery, and second that it is not durable. Neither allegation is founded in fact. Careful observations by competent engineers have established the fact that under the ordinary conditions of weather the number of accidents to horses from falling is greater on stone than on asphalt pavements. In London the proportion was found to be in the ratio of 191 to 132 in favor of rock asphalt. In American cities 583 to 413 in favor of Trinidad asphalt. And between the rock asphalt and the Trinidad, observations during the same period on two portions of Fifth avenue similarly situated showed 95 to 5 in favor of the Trinidad. Still more convincing to the ordinary mind are the statements of the Chiefs of the Fire Departments in Washington and Buffalo and the managers of large livery stables that they consider the asphalt the safest and best pavement for their horses and apparatus.

In regard to durability, asphalt resists wear more than ordinary sandstone, less than granite or trap rock, much more than wood or macadam. It is not the most durable of all pavements, but the most durable of smooth and noiseless pavements. Durability is only one of the elements of a good pavement, otherwise we should adopt chilled steel at once—and the same argument in clothing would lead us to wear canvas coats and wooden shoes. Asphalt pavements can be repaired, by those skilled in the industry, with great ease and such success that the repaired spot can not be detected after a few weeks traffic. The cost of these repairs is small, and during a term of years is less than for macadam or wood. It is but little greater than for granite if the surface of the granite is kept in proper order; and this difference is much more than saved by the decrease in cost of transportation and in wear and tear of vehicles. Asphalt is thus the cheapest of all pavements, for it can be maintained more cheaply than any other except granite, and for every dollar saved by the use of granite in place of asphalt at least two dollars will be spent in repairs of vehicles.

The Barber Asphalt Paving Company makes the broad claim that the Trinidad Asphalt Pavement is the best form of pavement yet devised, and in the long run the cheapest. In order to substantiate this claim—apart from the conclusive argument that over 3,500,000 sq. yds., or about 225 miles of it, have been laid in the last few years—it is necessary to state, briefly as above the advantages and disadvantages of the various forms of pavement that have been used in the past, and are now in use.

Tests of the New Direct Process Open Hearth Steel.

The tabular record of tests of steel manufactured by this new and interesting process, which we give herewith, cannot but be examined with great and general interest. Whether or not this new process plays as important a part as many think in our metallurgical future, we risk little in saying that never before since the world began was any metal ever produced at a single heat from the ore which would stand anything like such tests as these,

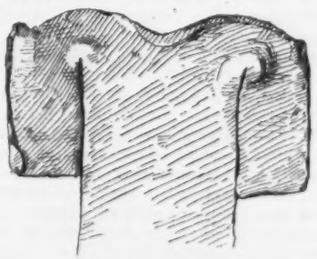
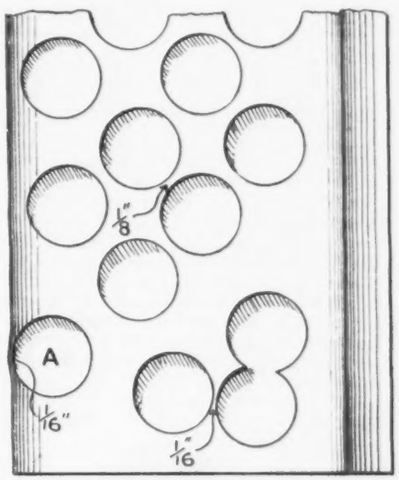
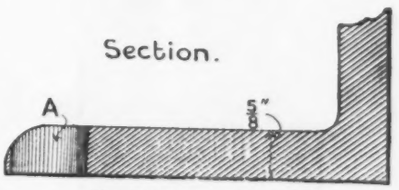


Fig. 4.—Flanging Test.

which are up to and beyond the standard exacted for the best structural steel. The remarkable properties of the metal are perhaps best illustrated by the engraving of the punching test which we give herewith, to one-half scale. Each of the holes are perfectly sharp and distinct, and the metal between shows no sign of having been injured or appreciably disturbed. The edges of the two holes which intersect each other, of the two only $\frac{1}{16}$ in. apart and of the one only $\frac{1}{16}$ in. from the edge (or beyond the point where the rounding of the edge begins) are especially remarkable. The thread of metal left in the latter case, is to all appearances as good and sound as any part of the bar, and shows a knife-edge at top and bottom. The appearance of the punched specimen seems to make it quite certain that the metal between the punch holes is far less injured than is ordinarily expected, even with the best material.



Plan.



Section.

Figs. 1 & 2.—Punching Test.

It is to be remembered that these are not patentee's or manufacturer's tests, but were made by prospective users of the material. We shall in an early issue give further and complete details of the process, which has not as yet been anywhere described. In the meantime we content ourselves merely with the foregoing and following details, for which we are indebted to Mr. GEO. H. THOMSON, bridge engineer, of the New York Central & Hudson River Railroad.

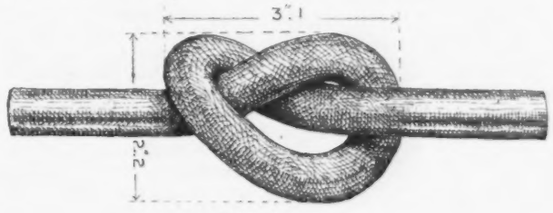


Fig.—3. Knot tied cold.

The specimens cut from angle-iron generally run about as follows:

Size	Elastic limit	Ultimate strength	P.c. elongation in 8 inches.	Reduction area, p.c.
1.1×.537	31960	64670	27	47.28
1.102×.525	36990	66030	26.5	46.84
.846×.580	35470	63900	28.	46.49

Angle iron 5×3×⅝. All fractures fine and silky.

After rupture, the broken ends were bent over cold (See Fig.—5.) and hammered down flat, without any sign of rupture. Other tests of still thicker angle-iron, ½ and ⅝ in., showed 37,000 lbs.

Tests of the new Direct Process Open-Hearth Steel, of the Carbon Iron Co., made at the shops of the Union Bridge Co., Athens, Pa., Dec. 28, 1887.

No.	Phosphorus	Carbon	Nominal size of bar or piece	Length out to out of Pin hole		Elongation		Per cent. in stated feet.	Pin Holes		Strength lbs. per sq. in.		Areas, square inches.			Remarks on Fractures.
				Before.	After.	in 8 in	in 12 in.		Diam. ins.	Elongation	Elastic limit	Ultimate	Original.	Reduced.	p. c. reduction	
49	.051	.19	5″×1″	15′ 0·2″	17′ 9½″	....	37.5	20.41 in 12′	4·77	0.76 0.81	35050	57185	4.888	2·536	48.13	Fine grey silky fracture at angle of 45°
,,	,,	,,	.493″×.971	.....	.....	24·1	.....	.....	.....	.....	32207	60480	0.4787	0·3020	36·91	Silky.
48	.022	.15	5″×1	14′ 2⅛″	16′ 10·05″	....	36·25	20·63 in 11′	4·77	0.69 0.85	34124	54443	5·02	2.891	42.43	Fine silky fracture complete cup.
,,	,,	,,	.498″×.985	.....	.....	22·8	.....	.....	.....	.....	31845	57840	0.4905	0·2998	38.88	Silky.
,,	,,	,,	6″×1″	10′ 10″	12′ 11·6″	....	30·83	22·91 in 8′	5·02	0.96 0.95	30695	54229	5.98	3.577	40.18	Silky center at angle of 45° fine granular on edges.
,,	,,	,,	.497×.996	.....	.....	26·5	.....	.....	.....	.....	29214	57152	0.4950	0·2867	41·82	
45	.046	.15	5″×1″	13′ 0·5″	13′ 0·7″	....	30·00	20·93 in 8′	4.77	0.77 0.86	32437	57984	5·03	2.677	46·77	Silky cup, little ragged in center with lamination.
,,	,,	,,	.494×1·004	.....	.....	24·4	.....	.....	.....	.....	31190	56996	0·4960	0.3018	39·15	Silky.
,,	,,	,,	6″×1″	19′ 11·7″	22′ 11·6″	....	30·00	15·73 in 17′	5·02	0.92 1.14	32186	58604	6·09	3·358	44·86	Fine silky cup center granular on edges.
,,	,,	,,	.498″×1·024″	.....	.....	20·2	.....	.....	.....	.....	34080	64260	0·5100	0·9612	29·18	Silky.

Note:—Excess of metal in head, about 50 per cent. Bars made by Cambria Iron Co.; manufactured by Union Bridge Co. All ingots poured from top.
Tests made by, M. Hunsicker and G. H. Thomson.

per sq. in., elastic limit, 64,750 ultimate, and 58 per cent. reduction of area.

From round steel, **0.20** per cent. carbon, 36,710 lbs. elastic limit, and 64,160 ultimate was obtained, with 26,75 per cent. elongation in 8 ins., and a knot tied cold in the same bar like that which we illustrate in Fig. 3. Such knots are by no means unknown, of course, in good material of other kinds, but only in the very finest material, and when we consider that this was tied in steel only one heat and three or four hours time off from the ore, it is quite without precedent.

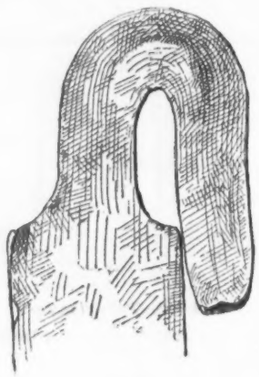


Fig. 5.

Blow 41 was overheated and burnt. A piece cut from a 5×1 in. bar *before* making into eye-bar, size 0.49×.995 showed:

Elastic limit	36,246
Ultimate strength	72,660
Elongation in 8 ins	15 p. c.
Reduction of area	14.6 "

Fracture, granular and square.
Phosphorus, 0.026. Carbon, 0.29.

A finished eye-bar, 5×1, from this same blow, showed the following results:

Out to out pin-holes	16 ft. 0.7 in.
Diameter "	4.77 ins.
Elongation "	11.7, 13.8 p. c.
Elastic limit	34,732 lbs. per sq. in.
Ultimate	64,620 "
Reduction area	33 p. c.
Elongation in 12 ins	23.33 p. c.
" 13 ft	12.18 p. c.
" out to out pin holes	11.4 p. c.
" in 13 12-in. spaces in inches	

1.1, 1.2, 2.8 (fracture), 1.5, 1.3, 1.1, 1.1, 1.0, 1.8, 1.6, 1.4.

Fracture, fine silky center	25 p. c.
" fine granular on edges	75 p. c.

Bar not annealed.

Another remarkable feature is that the bars show a higher elastic limit than small pieces cut from the same bar, and the elongation and reduction of area is also better in the large pieces. Of this, our large table gives sufficient evidence.

As respects flattening, a piece of angle-iron 16 in. long, 5×3×½ in. flattened out without fracture or crack at 90,000 lbs. The material also stands all flanging tests yet made.

A flanging test of a severe character is outlined in Fig. 4. A piece of plate was heated to divide it by a Y split, and it was then bent cold into the form which we illustrate.

Some punching versus drilling tests are in progress, to see whether the apparent indications are correct that this material is less deteriorated by punching than most others. Other further tests are also to be made shortly; of these and of the whole details of the process of manufacture we shall endeavor to keep our readers fully informed. None of the bars were annealed in any of the tests.

Thomas Coltrin Keefer.

(WITH PORTRAIT)

Thomas Coltrin Keefer, the newly elected President of the American Society of Civil Engineers, was born on Nov. 4, 1821, at Thorold, Canada, near Niagara Falls. His grandfather, George Keefer, was a Huguenot from Alsace, who emigrated from France, sometime before the Revolution, to the American Province of New Jersey where his son, George Keefer, 2nd. was born. In the struggle which preceded the separation of the American colonists from Great Britain, the original *emigré* adhered to the cause of the King and in so doing lost both his life and his property. In 1790 the father of Mr. Keefer went to Canada and died there in 1858.

Thomas C. Keefer was educated at Upper Canada College, and graduating in 1838, he commenced the profession of civil engineering upon the Erie canal. He very soon after this, however, entered the service of the builders of the Welland canal and was a division engineer on this work until 1845. In the latter year he became Chief Engineer of the Ottawa river works which he completed in 1848. In the year following his retirement from this work he wrote and published his "Philosophy of Railways," and also gained the Lord Elgin prize for the best essay on "The Influence of the canals of Canada on her Agriculture." This first named work earned for its author the right to be considered as the father of railways in Canada; and in it he argued that as the sparse population of that country would hardly admit of the construction of railways as a commercial speculation, it was the duty of the Government and the municipalities to aid this construction in every manner possible, both for the indirect profit arising therefrom and also to prevent wholesale emigration to the United States.

In 1850 Mr. Keefer was engaged upon the survey for the improvement of navigation upon the St. Lawrence river above Montreal, and upon the connection of this river with the St. Johns, either by rail or canal, by way of Lake Temiscouta. He was somewhat later appointed by the Canadian Government to act with U. S. Consul Andrews in a report upon the Canadian trade with the United States. The report then made, and the second report of 1852, in which Mr. Keefer again represented Canadian interests, led to the Reciprocity Treaty of 1854.

In 1851, Mr. Keefer made the preliminary surveys for the Grand Trunk Railway and for the bridging of the St. Lawrence at Montreal for railway communication with the United States. He was further appointed by Lord Elgin one of the Canadian commissioners to the London International Exhibition of 1851, and while in England for this latter purpose he advocated before Parliament the abandonment of the then Canadian rail gauge and the adoption of that prevailing in New York and New England; the wisdom of this suggestion was later realized, though only recently acted upon. In the discussion preceding the construction of the Montreal bridge the weight of professional opinion favored a bridge with a draw located across the wider portion of the river at Laprairie, above the city. Mr. Keefer, in his report, demonstrated that the feared ice-jams were due to unnecessary breadth of water-way, and he proposed bridging the narrower site at Point St. Charles and doing away with the draw by approaching the bridge at either end with an ascending gradient. The Victoria bridge, as constructed, proves by over 20 years experience the correctness of Mr. Keefer's views as then expressed.

In 1853, Mr. Keefer was made Engineer to the Montreal Harbor Commissioners, and he recommended an increase in the depth of channel, between Montreal and Quebec, from 16 ft. to 20 ft. In the succeeding years he constructed the water-works of Montreal, Hamilton and Ottawa, and was consulting engineer for similar works at a number of other places, including Quebec, Toronto, Halifax, St. Catharines and Dartmouth. He was also Chief Engineer to Railways in Upper and Lower Canada and was Commissioner for Canada to the London Exhibition of 1862, and was Executive Commissioner to the Paris Exhibition of 1878, being decorated as an Officer of the Legion of Honor for services in connection with his duties as a member of the International Jury on architecture and engineering.

Mr. Keefer has been very prominently identified with the inception and progress of the Canadian Pacific Railway and in the years 1869-1870, published a series of letters strongly advocating its construction as a step made necessary by the extinguishment of the claims of the Hudson Bay Company to the great Northwest territory and as essential to Canadian confederation and internal development. Since 1886 Mr. Keefer has been Chairman of the Royal Commission on the Floods of the St. Lawrence, and still holds that position. He is also one of the commissioners or arbitrators to settle the questions between the Dominion Government of Canada and the Canadian Pacific Railway, arising from the taking over by the latter of the Pacific coast section of the railway, which was built by the Government. This includes about 200 miles of the western end, built by Onderdonk & Co. through the Fraser River cañon. With Mr. Keefer, on this Commission are associated Wm. Gregory, C. E., of Halifax and Chancellor Boyd, of the Court of Chancery, of Toronto.

Mr. Keefer was elected a Member of the American Society of Civil Engineers on April 4, 1877, and was a Vice President of that Society during the last year; on Dec. 4, 1877, he was made a Member of the Institution of Civil Engineers, and in 1887 he was the first President of the Canadian Society of Civil Engineers, a new but exceedingly vigorous association. In 1878, Mr. Keefer was made a Companion of the Most Distinguished Order of St. Michael and St. George (C. M. G.), in further recognition of the same services as a member of the International Jury on Architecture and Engineering, for the Paris Exhibition of 1878, for which the French Government decorated him an Officer of the Legion of Honor,

The New York State Railway Commission's Report.

The fifth annual report of the Commission states in reference to the Interstate Commerce law that it has not had the harmful effect which railroad managers feared. For the fiscal year ending Sept. 30, the record of traffic and earnings shows a large increase over that of the previous year as follows:

	1886.	1887.
Gross Earnings	$125,160,289	$143,724,490
Operating Expenses	79,260,789	92,439,974
Net Earnings	45,899,491	51,284,515
Dividends Declared	11,178,176	13,822,874

The accident record shows an increase of 29 in the total number of people killed and 122 in the number of injured compared with 1886. The total for 1887 is, killed 532; injured 1,360. This increase was not due to defects in construction, rules or discipline of the railways, but to unpreventable causes and the misconduct or carelessness of the victims. In 1886 19 passengers were killed and 52 injured by causes beyond their own control, while in 1887 but 2 were

Yours truly
Thos. C. Keefer

killed and 35 injured from such causes. Among both employés and passengers, however, there is a large increase in the number killed and injured from their own carelessness.

Reference is made to the law abolishing car stoves, passed by the last legislature, which is said to practi-ly compel the use of steam heating from the loco-tive. The present effort toward agreement upon uniform coupling for the steam pipes between the cars is highly commended, and in adopting any form of heating it is recommended that the opportunity be taken to provide a good system of ventila- in connection therewith. The great advance in the past two years in uniform rules and als for train management and the probable early settlement of the question of uniform automatic couplers and continuous train brakes are also warmly commended. The following subjects are recommended for legislation. The empowering of the Commission to compel obedience to its decisions; the prohibition of grade crossings on railways that shall be hereafter built, and authorizing the removal of grade crossings on existing lines where a commission appointed by the Supreme Court shall decide that such action is called for in behalf of public safety. The abolition of the center bearing rail on street railways; the prohibition of the leasing or purchase of parallel roads; the regulation of railway construction; the responsibility of railroad corporations for fires caused by sparks from their locomotives; the construction of low railing around the roofs of freight cars to prevent brakemen falling off; the regulation of the issue of bonds by railway corporations.

The Weather of the United States for the Month of December, 1887.

[As respects the elements of most interest to engineers.]
According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Hardest in 24 hours.	No. rainy days.
Northern Cities.										
Northfield, Vt.	20.9	43.3	−21.0	64.3	8.0	40	NW	5.88	2.14	15
Portland, Me.	27.9	54.8	−1.8	56.6	7.9	51	SW	5.17	2.07	14
New York City.	36.1	56.4	11.6	44.8	9.5	50	W	4.20	1.01	14
Pittsburg, Pa.	36.3	61.5	7.5	54.0	7.7	34	SW	1.99	0.80	14
Chicago, Ill.	28.1	53.4	−4.8	58.2		30	WSW NW SE	3.67	1.04	13
Omaha, Neb.	23.6	48.5	−14.5	63.0	9.2	42	NW	1.11	0.47	6
St. Paul, Minn.	17.1	41.1	−22.0	63.0	5.0	26	E	1.47	0.31	16
Duluth, Minn.	17.9	44.1	−17.4	61.5	19.9	35	NE	2.67	0.80	20
Bismarck, Dak.	9.4	47.1	−25.2	72.3	8.0	44	NW	0.80	0.24	12
Average	24.1	50.0	−9.7	59.7	10.4	39		2.99	9.87	13.8
Southern Cities.										
Washington City	37.0	59.0	14.0	45.0	5	33	NW	4.31	0.92	11
Louisville, Ky.	36.5	60.2	4.0	56.2	7.7	36	SE	3.03	1.22	13
St. Louis, Mo.	31.5	58.0	−2.0	60.0	12.4	50	NW	3.54	1.40	10
Savannah, Ga.	50.8	70.6	28.0	42.6	6.5	30	W	7.99	3.71	7
Leavenworth, Kan.	27.2	62.2	−9.8	72.0	7.3	28	NW	2.55	1.37	13
Jacksonville, Fla.	55.6	76.3	31.0	45.3	6.5	36	W	3.70	1.47	17
Chattanooga, Tenn.	40.1	59.5	13.3	46.2	6.0	36	NW	5.46	1.21	15
New Orleans, La.	52.9	77.0	29.4	47.6	8.9	33	S	7.56	1.69	14
Memphis, Tenn.	40.6	62.0	14.5	47.5	6.7	38	W	5.80	1.59	16
Palestine, Tex.	45.6	78.8	10.6	68.2	9.2	36	NW	6.72	1.99	12.6
Average	41.8	66.4	13.3	53.1	7.6	35.4		5.07	1.66	12.6
Far Western Cities.										
Helena, Mont.	23.0	54.5	−13.2	67.7	5.7	36	SW	0.29	0.12	15
Fort Angeles, W. T.	Reports not received.									
San Francisco, Cal.	51.7	69.3	40.4	28.9	6.9	35	SW	3.34	1.14	12
Salt Lake City, U.	29.7	49.7	8.7	41.0	4.6	40	S	1.55	0.58	13
Denver, Col.	28.8	66.6	−13.6	80.2	7.0	36	S & W	0.14	0.05	5
Yuma, Ariz.	53.1	72.5	27.1	45.4	7.7	40	N & NW	0.15	0.15	1
Santa Fé, N. M.	26.8	45.5	−8.0	53.5	5.3	36	W	0.32	0.18	4
Average	35.5	59.7	6.9	52.8	6.2	37.2		0.97	0.37	8.3

Report of the State Engineer of New York.

Mr. ELNATHAN SWEET, late State Engineer and Surveyor for New York, has issued his report for the past year. According to this report the amount of freight moved on the canals from May 7 to Dec. 1 was 5,553,804 tons, which is considerably in excess of the average canal tonnage for the last 12 years. The most important improvements during the year were the lengthening of locks 47, 48, 49, 51 and 52 on the Erie canal, guard lock 1 and locks 5 and 6 of the Oswego canal. The length of the lock-chamber has been doubled so as to admit the towing of boats in pairs which is now almost the universal plan on the Erie canal. Lock 72, at Buffalo, and 15 other locks on the Erie and 2 on the Oswego canals are in process of similar improvement; other improvements on the Champlain, Black river, Cayuga and Seneca canals and bridge construction is also being carried on under a total appropriation of $672,000.

Mr. SWEET recommends, as urgently needed to insure a sufficient and certain water supply to the Erie, the completion of the dam at Forest port, (estimated cost $43,000) and the replacement of the wooden dam at Little Falls by one of masonry ($15,000). The removal of deposits in the canal and the restoration of the original prism of the canal is again urged at a cost $100,000. Sixteen more locks should also be improved at an estimated cost of $450,000.

On the subject of the State Survey the Chief Engineer says:

Though the survey has given the State a little trigonometric work of a very high grade, it is of very little value for the purposes of a topographical survey and map, which the State needs. Major POWELL, director of the United States geological survey, the highest authority we have on topographical work, in his letter published in the report of the Commissioners of State survey, estimates the cost of triangulation for the purposes of such a map at $1 per sq. mile, while all the work done by our trigonometric survey, in which the subdivision of triangles has been carried far enough to meet the requirements of a topographical survey, has cost more than four times that rate. In the light of the experience of New Jersey and Massachusetts, it is very clear to me that the proposition of Major POWELL, outlined in the letter above referred to, offers the happiest possible solution to our survey problem. Both Massachusetts and New Jersey have secured through the coöperation of the United States coast survey and the United States geological survey, creditable topographical surveys of their entire territory, with the free use of the engraved plates for their maps, at a less cost per sq. mile than we have paid for our experiments with the State and Adirondack surveys, supposing their aggregate cost divided by the whole area of the State. In both their cases the surveys were made by the trained corps of assistants of the coast and geological surveys, and subject to the inspection of representatives of the State.

He suggests a plan of coöperation with the Geological, Coast and Geodetic surveys, which limits the expenditure by the State to $40,000 per annum, and the total expenditure to $400,000. The cost of the boundary examination has been $2,324, and $1,500 is asked for to complete the remonumenting of the Massachusetts boundary.

Some of the Benefits of the River and Harbor Bill in North Carolina.

Capt. W. H. BIXBY, U. S. Engr's., in charge of river improvements with headquarters at Wilmington, N. C., writes a letter setting forth some of the benefits conferred by river and harbor work in that section. He says—that on the Trent river, since 1879, about $42,000 has been expended in opening up 40 miles of river, with the result of reducing freightage from 25 to 75 per cent., and increasing commerce by $250.000 per year, thus showing a development of $6 of annual commerce for each dollar spent by the government. On Contentnea Creek, N. C., since 1881, $34.000 spent in opening 30 miles of river has reduced freightage from 12 to 50 per cent., and built up a commerce of $600,000 per annum; or, a development per annum of $17 for each government dollar expended.

On the Pamlico and Tar rivers, since 1876, $56,000 has been expended in opening about 60 miles of river, with a freight reduction of from 12 to 50 per cent. and a gain in commerce of $1,800,000 per year, a developement of $32 per annum for each dollar spent. Besides this Washington, N. C., has increased 25 per cent. in population, and Greenville has increased from 912 inhabitants and $266,000 real estate valuation, to 2,505 citizens and $600,000 valuation in 1886.

On the Neuse river, since 1878, about $220,000 has been used in opening 70 miles of river, with the result of reducing freight rates 25 to 75 per cent. and increasing commerce $1,800,000 per annum; or an annual development of $8 for one spent by this government; while the whole river basin is also gaining in population and prosperity. On the Cape Fear river the expenditure of $1,800,000, since 1829, has improved 26 miles of river, increased the available draft from 7½ ft. to 16 ft. in 1886, and increased foreign commerce by $4,500,000 per annum since 1871. On this same river above Wilmington, since 1881, $66,000 has opened up 112 miles of river, reduced freight rates 33 per cent. and developed an annual commerce of $1,200,000.

On the Great Pedee river, since 1880, about $37,000 spent has opened up 200 miles of river, and cotton that formerly cost $1.75 for transportation by wagon and rail is now sent on the river for 75 cts. The annual commerce is increased by $1,600,000, showing an annual return of $43 for each Government dollar expended in the original improvement.

Capt. BIXBY then proceeds to point out various points in both North and South Carolina, where a similar bountiful return can be expected from wise expenditure in improvements by the Government. Among these he mentions the improvement of Winah Bay, with the expected result of developing the Santee and Pedee river basins, which comprise two-thirds of the entire State of South Carolina, and the quick development of an additional South Carolina commerce of about $8,000,000 per annum.

The Mead Regenerative Gas Lamp.

On Monday evening, Jan. 16, the National Meter Company of this city put on exhibition a new regenerative gas lamp which they have just placed upon the market.

In this lamp the gas is first passed through a regulator which ensures a uniform flow of gas regardless of variation in pressure. The gas then passes down in the center of the argand burner and is heated to a high temperature when it reaches the orifice of the burner. Any particles of combustible matter not consumed in the passage of the gas through the jet are thrown upwards from the flame and pass into an annular opening which leads down to the base of the burner, thus heating the air supply.

The light is thrown downwards by a porcelain hood enclosed in the upper, ornamental part of the lamp. Chains hang from each end of a beam above the lamp, by pulling which the gas is turned on or off. The main part of the burner can easily be taken apart by anyone, should it be necessary to do so.

The lamp is especially designed to supercede the ordinary chandelier, and the claim is made that it saves at least one half the amount of gas consumed by the ordinary chandelier in producing equal light. This saving is effected by the economy of the regulator, the heated air and heated gas, as described above.

The lamp gives a white light of great intensity and doubtless will prove a formidable rival to the best electric lights now used for interior lighting, while its various merits bid fair to make it a favorite for domestic use, the price being a very reasonable one.

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Coming Technical Meetings.

Civil Engineers' Club of Cleveland, O.—Intermediate meeting, Jan. 24. (Railroad Engineering branch of the club).

Engineers' Club of St. Louis, Mo.—Regular meeting Feb. 1.

American Society of Civil Engineers, New York.—Regular meeting, Feb. 1.

Engineers' Club of Philadelphia, Pa.—Regular meeting, Feb. 1.

Engineers' Club of Kansas City, Mo.—Regular meeting, Feb. 6.

American Institute of Mining Engineers.—Annual meeting at the Institute of Technology, Boston, Mass. Feb. 21 to 25

American Society of Mechanical Engineers.—Meeting at Nashville, Tenn., in April or May.

Master Car Builder's Association.—Next convention at Alexandria Bay, N. Y.; commencing June 12.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y. June 19.

WHILE the description of the proposed bridge across the English Channel, given no our engineering news page, sounds like a very large sized venture and is probably as yet little more than an "idea," the boldness of the design alone shows the advance in engineering since the last similar scheme was broached. No sane man would have even suggested, a decade or little more ago, truss spans of such enormous proportions and weight; but the public of to-day read of these things with complacency and a full trust that, if the thing should be done and can be looked upon as promising good dividends, both engineers and capitalists will be forthcoming to put the scheme into execution.

BUT with all due respect to the well known names the report couples with this bridge, there is solid work ahead for the best of them if an attempt is really made to bridge the Channel. We will admit that, with money provided, the engineers of to-day are fully capable of designing a span of 2,000 ft. and more; but it seems to us that the chief problem to be solved will be in founding piers in the rough Channel to set these trusses upon. The dredging operations at Hawkesbury, referred to as a precedent, are being carried out under very different conditions, and trouble has been met with there; and the experience at Poughkeepsie shows what can be expected from strong tidal currents acting upon the enormous submerged surface required for the Channel piers. Getting such a pier down in 150 ft. of water, in an exposed channel connecting two oceans, will be a tough problem for any engineer with the most elaborate plant.

FROM a purely engineering standpoint the tunnel scheme is after all undoubtedly the most economical and certain under the conditions surrounding this Channel project. The trial tunnel has practically demonstrated the fact that water, the only enemy to be particularly feared, is found in very small quantity in the chalk stratum underlying the sea at this point. With sound ground insured, the only other serious question is that of ventilation. and this can readily be secured by compressed air or other means. The chalk itself is one of the easiest of materials to be bored, and Col. BEAUMONT'S tunneling machine has already demonstrated the fact that progress can be simple and rapid. The invasion bug-bear, that seems to block all progress in a tunnel scheme—by Englishmen at least—is a ridiculous objection to make to a project of international and commercial value in this year of grace. In the first place there is little danger of an army getting into a hole under the sea that might be flooded by a half-dozen expedients secure from foreign interference; and in the second place the day is past for expecting an invasion of British soil by Frenchman. The site is one calling for a tunnel rather than a bridge, from both a natural, financial and engineering point of view.

A very lucky and very curious breaking of a pair of connecting rods happened to the locomotive which was about to take out the New York Central limited from Albany last Monday. It was side-tracked awaiting the train, which arrived nearly a half hour late. When the train arrived it took its position at the head of the train, but when the time came to start and the throttle was opened, it did not move an inch. A full head of steam had been let on, but instead of the usual results, a loud snap was heard. The steam was immediately shut off, when it was found that the side-rod on one side had broken loose from the rear drivers and fallen to the ground, the connecting rod-pin, about five inches in diameter and made of the best solid steel, having broken off close to the wheel. The driving-rod on the left side had also broken through the bearing. The cause of the accident is unknown, but it was certainly very strange that both rods should have broken down at the time and in the way they did.

THE following comes to us from Buffalo:

"The rapid increase of our population allows us to call our city a great railroad center, but some of our prominent citizens are still in the Kindergarten period of their education in railroad matters.

"A conference was held yesterday between the counsel and engineers of one of our new roads; to elucidate some point the chief engineer displayed a progress profile, the gaudy colors caught the eye of the counsel and they viewed it admiringly although it was upside down. At last the senior counsel said: "What is this?" "This" said the chief, "is a progress profile of Section 3. This is the excavation, and this the embankment." "I understand all that perfectly; but what is this red line?" "That is the grade line." "Are you not mistaken," said the senior, "are not all grade lines necessarily horizontal?" There was a pause: then the chief said softly, as he rolled up his profile. "No, not always."

"Shades of Tom Wiggleworth! how far could the Colorado Midland have gone towards Leadville with a level grade?"

The anecdote is certainly a good one, and shows the consequences of meddling over-confidently in what one does not understand. But it may also serve as a warning to engineers as to how easily they may make themselves a laughing-stock by wrong action or advice on business, architectural or other questions, with which their legitimate duties give them a certain kind of familiarity, but in which they often make calamitous mistakes.

THE *Arkansas Press* "fully explains" the fall of the reservoir wall at Little Rock, Ark., referred to in our issues of Nov. 12 and Dec. 3, 1887, and disputes the correctness not only of our own deductions but those of a "number of societies composed of scientific men" who have discussed the matter. The explanation is that:

"The cause of the accident was solely due to the geological formation of the ground, which is at variance with nearly every law of nature. The primitive whinstone, or trap-rock was found lying upon a loose bed of rotten sandstone, enclosing a strata of fire-clay or soapstone." (This natural ground is stated to have slipped and carried the wall with it.)

While the geological peculiarities as described may be held accountable for almost anything, the line must be drawn at a design for a reservoir wall which would found this structure on the natural face of a rock pitching 17 ft. vertically in a horizontal distance of 12½ ft. As this wall was 35 ft. high, it is not remarkable that the "law of nature" came into play very effectively when the attempt was made to load the upper half of the wall, on one side only, with water; the bondless masonry toe was not equal to the task assigned it by the amateur engineer. If the "rotten stratum" did exist, it should have been removed; and if it had not existed at all, the wall would doubtless have failed all the same.

THE recent action of the Chamber of Commerce in regard to the pavements of New York, directs renewed attention to this well-worn but yet unsolved problem. The present time seems favorable, however, for some final solution of this vexed question of the best form of street pavement. For the first time in many years the City of New York has at the head of its Department of Public Works an official who is not only an engineer of long training and wide experience, but one in whose integrity the entire community has the fullest confidence; his chief deputy has grown up in the Department, and for many years has had charge of the paving bureau, and the Board of Estimates and Apportionment has voted the full amount of money asked for paving during the year 1888. Under these unusually favorable conditions the public will naturally expect some definite action in this matter; and if the work of 1888 shows an improvement over the deplorable condition of recent years, as it should, there will doubtless be a strong sentiment in favor of large expenditures for the purpose of putting the streets of this metropolis in the condition which its commercial interests and the comfort of its citizens require.

ON another page of this issue will be found an interesting article which states the claims of asphalt pavements and incidentally discusses the merits and demerits of other kinds of pavements. While we in nowise hold ourselves responsible for the particular views advanced, we still deem it very worthy of careful consideration. The authorities of New York have so far confined their selection to some form of stone pavement, with little regard to location or service expected; while London, Paris and Berlin have realized that comfort, cleanliness and ease of traction are also features in the general problem. As remarked in the article referred to, durability is not the only thing to be considered in selecting a paving material; it is but one of the elements, "otherwise we should adopt chilled steel at once—and the same argument in clothing would lead us to wear canvas coats and wooden shoes." The old practice has been to put down stone blocks and let the pavement wear out, without efficient repair and very little attention paid to it after the original pavers left the street. The disastrous and disgraceful results of this method of not-doing-it need no pointing out, and it is now time that our au-

thorities studied the matter in the same light as in London and the chief Continental cities, and gave us something like the street pavements of other civilized communities, rather than the uneven rock surface which now covers the greater portion of our streets, whether the expected traffic is from drays or pleasure carriages.

WE hope it is a sign that sanitary precautions are merely better understood and looked after, rather than that we are still to a large extent in a barbarous condition in that respect, that there are such constant reminders coming to the surface of the dangers of bad sanitary work, and of the frequency with which it is met with even in quarters where it would least be expected. One cabinet officer has recently died from bad plumbing in the Treasury building; the Mayor of New York has had to move his office for the same cause, and as if this was not enough, we find reports this week of similar conditions in public buildings of at least three other cities. The Mayor's office in New York was a particularly shameful case. It was found that the waste-pipes from it had no sewer connections but had been for several years emptying their contents under the basement floor to soak into the ground! The writer of this article can speak feelingly on this subject, as he has himself recently lost two months from sickness due to a precisely similar cause, and that in a quarter of the city where it should certainly have been least expected.

If the actual state of the sanitary appliances of any one of our cities could be suddenly and completely revealed, with a record of the resulting deaths for a single year, there can be little doubt that it would create a sensation vastly greater than the worst railway accident and show a death-roll exceeding in rate that of the whole continent from the latter. But the deaths unfortunately come one by one, with no dramatic or spectacular accompaniments, and the intelligent public reserves its interest and indignation for the comparatively trifling affairs in which 40 or 50 people are killed at once, without the lingering suffering of a previous illness. Perhaps this will always be so, but we hope not.

WE are pleased to learn that the Cincinnati Southern management has taken the hint from the confusion of the names of two adjacent stations, Somerset and Summit, in a train order, which caused the late serious collision on that road commented on in our issue of Jan. 7. The name Summit has been changed to Tiptop, removing all danger of further like mistakes. A similar change should be made on every road which has two names of stations on a division which by any possibility could be confused with each other from bad writing of either; and we have no doubt that search would reveal many such stations on many roads.

Rail Wear in India.

If we may judge from an article which appears in *The Indian Engineer*, which is stated to be published "by permission of the Institution of Permanent Way Inspectors," although the author's name is not given, the art of railroading is in a decidedly backward condition in that country. That it is not so in all respects is well enough known, for their financial results show very economical working, but the long illustrated paper to which we refer makes it too clear for doubt that in the art of braking and handling trains at least, East Indian practice is in an almost ridiculously backward condition.

It appears that various East Indian roads are troubled with the production of long shavings from the rails, which are thus explained.

"These metal shavings are found in large quantities and frequently of great length in some places, and are variously accounted for. They are sometimes found as long as 18 ins., but more generally from 4 to 8 ins. long, being entirely dependent on the condition of the permanent-way, the even velocity of the rolling load or train, and the freedom of the rails from crossings or switches. The least obstacle to the smooth passage of the skidding wheel will terminate the continuity of the flowing metal, and consequently the length of the shaving."

Drawings are published showing such shavings 13 and 14 ins. long and weighing from half an ounce to an ounce, and also showing how the shaving curls away from behind a skidding wheel. The "recently introduced iron brake-blocks," it appears, are by many considered as the provoking cause, and hence there are apparently some who wish to return to wooden brake-blocks, but as iron brake-shoes have been used here from the beginning it can hardly be due to this cause, besides which it is alleged in the article that the evil has grown less rather than more since this "recent introduction."

It appears too that air brakes are now fitted to a large proportion of the trains, and it is gratifying to learn that with them "stoppages are now made in short distances and invariably without skidding the wheels," but directly after we have this amazing declaration:

"In stoppages of trains not fitted with continuous or steam brakes, but stopped by hand brakes, and, therefore, having less power to stop in short distances, the wheels of engine-tender or brake-vans, or of both, *are invariably skidded for considerable distances.* The shavings produced by wheels and iron brake-blocks are found not to exceed 5 to 10 grains Troy. The larger shavings are produced by extensive skidding of wheels—invariably wagon wheels—on heavy inclines from 1 in 100 to 1 in 30 or more, and are often found to weigh from 6,000 or 7,000 grains Troy.

"From the excessive wear of the rails where these metal shavings are found, it is evident that a proportion of the shavings consists of the rail metal. The large sizes—from 20 grains upwards—undoubtedly are from both rails and wheels, being the fusion of two similar metals by the intense heat generated by the skidding of the wheels, the size and weight being dependent on the load upon the wheel and on the length of uninterrupted surface of rails and uniformity of velocity of the train. The smaller shavings, of 5 to 10 grains Troy, may be the product of the wheel metal and brake-block metal from the friction of both, but being dissimilar metals—and although instances have occurred where the friction has made the iron brake-block red hot—it is improbable that they are combinations of wheel and block, but of wheel metal only."

From the accompanying investigations it appears that the normal life of rails is found to be about 109,725,000 tons, in trains of an average weight of 220 tons, this sufficing to produce a wear of about 10.08 lbs. per yd. At this rate, the life of good steel rails under normal wear is found to be *at the rate* of 39 years for the given traffic, a promise which we sincerely hope will be more completely realized in India than it has been in America. There have indeed been many thousand tons of rails laid in this country that would and have realized such a duty, and that in fact are still in the track after sustaining a heavy trunk traffic for 18 or 20 years, but there are few rails laid now-a-days that will stand any such service, and we fear that even under the most favorable conditions few of these newer Indian rails will realize it.

But these figures are only for rails on grades of level to 0.5 per cent. When we come to the steeper grades, where the shavings are taken off by the skidded wheels, the showing is fearful. The wear of rails for miles together is increased four or five times, so that their probable life falls to 11 or even 8 or less years, their life in tons being reduced to 11,000,000 or 13,000,000 tons; and this almost wholly because of the fearful looking steel worms a foot or more long, to picturing which our contemporary gives up a half a page, and the like of which cannot be found in the whole length and breadth of this continent. One of the longest of these, was produced by a wheel skidding 2¼ miles, another by skidding ¾ mile, and the general rule seems to be that the wheels are regularly skidded on all down grades of 1¼ per cent. or more. As a natural effect one sample drawing of a wheel is given with a flat spot 4 sq. ins. in size backed at the rear by a bunch of fused metal on the tread projecting beyond the normal circle. Bad flat spots are not at all unknown in American service, but nothing at all like this, nor is there any such contrast between the wear of rails on grades and on levels as is shown in these records and some similar English ones. In fact the best observations show little or no difference between the rail-wear on grades and on levels, except such as can be readily accounted for by the fact that there is a much larger proportion of engine tonnage on the former because of the shorter trains.

A neglect to allow for the excessive rate of rail wear from engines in an attempted comparison of the rate of wear on grades and levels was a serious defect in an investigation made by Dr. CHAS. B. DUDLEY for the Pennsylvania Railroad some years ago.

The trains being only about one-third as long on an average on the heavy grades as on the adjacent level division, and a ton of engine being beyond doubt vastly more destructive to rails than a ton of cars—although precisely how much no one can definitely say—the comparison became a very delusive one as indicating the wear of rails *due to grade only.* To have had the comparison a fair one it should have been made between rails from levels and grades on the same division or not made at all. Had it been so made, the burden of evidence is that there would have been no very material difference discovered.

Some investigations by Mr. PRICE WILLIAMS, however, on the "Maintenance and Renewal of Permanent Way," embodied in a paper before the Institution of Civil Engineers in 1866, showed an excessive wear of rails on grades in England, very similar in its nature to that so lately reported from India. He found that on a down grade of about 42 ft. per mile, iron rails were renewed in three years, after sustaining a traffic of 65,500 trains, or 13,500,000 tons, whereas at another point, on a level, they were renewed only after 7¼ years, having sustained 203,000 trains or 38,000,000 tons. From these conclusions, and other analogous facts, Mr. WILLIAMS concluded, and doubtless with truth, that the wear of rails was several times greater on down grades than on levels, or even on up grades. As the same kind of brakes were in use there as now in India, and as similar shavings of metal have been frequently complained of in England (although never yet alleged to occur on such an extensive scale as in these Indian records, to our knowledge) it is probable that this excess does occur in England and is due to the same cause as in India,—a cause which we are happily free from.

The English hand brake gear for both freight and passenger cars, appears to an American an absurdly feeble and awkward contrivance. We have all heard of the countryman who loaded his mules with a bag of wheat on one side and a bag of stones on the other to balance the weight; but the running of separate "brake-vans," merely to get weight, and sometimes loading them with pig metal, to brake with, with no brakes on the rest of the train, is certainly quite as absurd, and of course gives a brake power which is

apt to be dangerously feeble. In freight service, where the brakes are applied usually to the "wagons," the supply of brake power is also very scant, and there is naturally much skidding. Hence probably the resulting excessive rail-wear on grades, both in England and India, from which we are certainly almost free.

"There is something not altogether unpleasing to us in the misfortunes of our best friends," said MONTAIGNE, and certainly whoever is disposed to be annoyed sometimes at the slow progress of desirable improvements in our own land may fairly find a little gratification at such clear evidence that we have advanced far beyond all danger from some evils which oppress other people. It would be far better, however, to wear out rails as they do in India, *and have good ones*, than not to do so at all and have such rails as are laid down by the thousands of tons every year in this country. Until we have learned to regulate the quality of rails more effectually, therefore, it does not become us to throw many stones.

The Haverhill Accident.

We have received a letter from Prof. J. V. HAZEN, of the Chandler Scientific School of Dartmouth College, giving a description of last week's disastrous wreck on the Boston & Maine which corresponds closely with the data from which was prepared our report of the accident in the last issue. We are pleased to acknowledge Prof. HAZEN's courtesy, although in this case we were already in possession of the facts; and wish that more of our readers would follow his example whenever any disaster of professional interest comes under their notice.

One point mentioned by Prof. HAZEN, however, deserves a word of comment. He remarks that the super-elevation of the outer rail seemed to be too small for the speed at which the train was running. Also Road-master JOHN BAILEY testified before the Railroad Commission: "The elevation was 2½ ins. which is computed for trains going 40 miles an hour." It will probably be a long time before it comes to be understood by practical men that the nice little theory which adjusts the super-elevation to correspond exactly to the speed of the train is about as truthful as was the old hoax of coned wheels.

In both cases the error results because the the theory does not take into account all the facts of the case. The great force which presses the outer leading wheel of the truck against the rail, comes from the tendency of the wheels to roll in a straight line, a matter which is quite independent of speed. The centrifugal force from the train's motion and the centripetal force due to the super-elevation also act upon the train, but their amount is so small compared with that of the first force that they do not appreciably increase or decrease the tendency of the flange to mount the outer rail. As for the opinion which has been most prevalent in the popular mind, that the accident was due to "running too fast on a curve," it follows from the above statement that the tendency to derailment is not much affected by speed, and experience teaches that derailments from curvature are so infrequent that it cannot be positively asserted that it is a cause of derailment. The commonest expression about the scene of the accident was "trains ought not to be allowed to run more than 15 or 20 miles an hour on curves." The dense ignorance of the average man upon mechanical and technical matters is well illustrated by the comment.

A very interesting matter was brought out in the Commissioners' examination of the car inspectors. One man testified that he never rapped wheels with a hammer but trusted to his eyesight. Another inspector once told him that he had instructions to rap the wheels with a hammer, "*because it gave a better impression to the public.* When they heard the rap they supposed the wheels were all right." Another inspector sounded the wheels "because Mr. Richardson ordered it done." If the travelling public has been awakened from its sleep by the tapping of car wheels all these years since railway travel began, simply that it might be deceived into a fancied additional safety, it is about time that it was left to sleep on in peace. *If* ringing car wheels is all a piece of sentimental foolishness, let us acknowledge it and put a stop to it forthwith.

The testimony of the switchman at Bradford should be the most important of that of any employe in throwing light on the exact cause of the disaster; but the man—who by the way is an unpromising specimen of the genus Homo—did not say anything of importance, except to state that he "did not know what kind of a switch it was" of which he had the charge. For the especial benefit of any who may think we took too positive a stand in ascribing so large a portion of the blame for the disaster to the stub switch, we would call attention to the report in another column of the New England Railroad Club's discussion on the day following the disaster.

A word on the car heating question seems also opportune. The train was equipped with the Baker heater, not with steam heat from the locomotive, as has been frequently stated by the newspapers. The car which was flooded by the water tank was of course in no danger of burning. The other two cars behind it were not badly wrecked. The heater in the smoker was broken and the coals were scattered on the floor, but the majority of testimony seems to show that a pipe burst in the heater and put out the coals. Be that as it may, the fortunate circumstance of the absence of fire at the wreck should not be taken as an argument for separate heaters and against continuous heating. It was only a happy chance that saved the wreck from fire; and to rely on accidental circumstances for safety instead of insuring it, is, to say the least, not good railroading.

The company has reason to congratulate itself upon its adoption of automatic brakes, which occurred not so very long ago, if we are rightly informed. It was probably due to these that the smoking car was stopped with no worse injury to inmates or to the bridge than was the case. The two rear cars would doubtless have gone farther and fared worse had it not been for them, and the fact that they did go so far and that the third car struck the water tank with such force was probably due not to any fault of the brakes but to the hard frozen ground which offered so little frictional resistance that the wheels probably slid over it without rolling.

Finally, we would not wish to be understood as stating that the Boston & Maine company seems to generally disregard the comfort and safety of its passengers. Its rolling stock seems in excellent condition; Its tracks are laid with heavy steel and appeared in good line and surface. It is for its slowness to introduce improved modern safeguards, whose worth over the old devices is abundantly testified by years of experience, that the management is deserving of reprimand; and we trust the list of fatalities at Bradford will teach managers of this corporation, as well as others more fortunate but not less reprehensible, a salutary lesson.

"Division" and "Resident" Engineers.

A question of more practical importance than appears at first sight was almost accidentally brought up at the late Annual Meeting of the American Society of Civil Engineers, and after a brief discussion referred to a committee which we hope will settle an annoying confusion of practice in regard to the titles of engineers. The confusion of practice perhaps is most conspicuous in railroad work, but it exists in almost equal degree on large engineering works of all kinds.

As most of our readers have had occasion to know, about the only engineering title which has one invariable and well understood meaning is that of Chief Engineer. The titles of Principal Assistant, Division, Resident, Assistant Engineer, and what not, may mean anything or nothing according to circumstances. The greatest confusion is as regards the two titles of Division and Resident Engineer, each being sometimes the highest and sometimes the lowest title. The committee of three which was appointed however, (consisting of Messrs. WHITTEMORE, ROBINSON and RANDOLPH) was instructed to report on the proper gradation of engineering titles generally, and remedy the confusion now existing.

The original source of the "Division" and "Resident" confusion is easily determined. Engineering works on a large scale began in England, somewhat earlier than in this country, and were then, and are now conducted in a radically different manner from what is usual in this country. The engineers at the top of the profession are not engaged on salary to conduct some one work, but have for the most part their main offices in London and accept (if they are lucky enough to get it) the direction of works in all parts of the English Empire and the world generally: and for the most part (especially in former days) on commission rather than on salary. From this it has resulted that there are and always have been a short list of engineers in England who are able to command incomes out of all proportion greater than men of equal engineering rank in this country enjoy, or the next grade below them of English engineers command, which latter rule on the whole considerably lower than in this country.

The original cause of this practice, the disadvantages of which are apparent, was probably that at first there were only two or three engineers in the world at all competent to build railways. In fact, for some time there was only one, GEORGE STEPHENSON, and both he and his son conducted dozens of works at a time, as have their many successors. But the practice has been continued by reason of the necessity of a great deal of parliamentary work to get any project through, so that this favored class are largely known as "parliamentary engineers," and often owe their advancement far more to that than to strictly technical qualifications. As "nothing succeeds like success" and as apparent more than real engineering skill is what is wanted to push projects before Parliament and capitalists, an additional cause has tended to perpetuate a system which begun naturally enough, and which, we may add, has its good side as well as its bad. The Engineer *par excellence* not being "resident" on the work, and often on the other side of the globe, the practice naturally grew up of appointing a "resident" engineer in general charge in distinction from the non-resident London chief, and the "resident" in his turn cut up his work into "divisions," or in any other way which suited him.

This English nomenclature was naturally copied on the earlier American works, al-

though the provoking cause for it did not exist. On the Erie canal for example, and on many other early works, the next officer to the Chief was a Resident engineer. Other great works, like the Pennsylvania Railroad, appointed numerous "Principal Assistant" engineers, corresponding exactly to what are more commonly called Division or Resident engineers, and this is still occasionally done on quite small works, which consequently have often a considerable number of high-sounding titles with very little real responsibility attached to them.

The original English nomenclature has been embalmed in the constitution of the American Society of Civil Engineers, which declares that "A member shall have had responsible charge of work as Chief, *Resident* or Superintending Engineer, not as a skillful work man merely, but as one qualified to design as well as to direct public work," thus clearly using Resident as the next highest title to that of Chief.

The opposite custom has had an equally natural origin from American practice. Every long railway, at least, is cut up into operating divisions of 100 miles, more or less, in length, and as it is likewise designed and built by divisions to a large extent, analogy naturally indicated that each should be in charge of a "Division" Engineer, directly under the Chief, or, if the Chief felt unequal to the entire general charge, under a "Principal Assistant;" or "Assistant Chief" Engineer, likewise in general charge, Such "divisions," being necessarily cut up in smaller sub-divisions, each in charge of an assistant to the Division Engineer, who was "resident" on his sub-division, what can be more natural than to call these subdivisions "residencies" and transfer the title of Resident Engineer to the assistant in charge, thus causing a complete inversion of its original rank? This is on the whole more common than any other practice in America, but in part from this very confusion, the non-committal title of "Assistant Engineer" is also very largely used for engineers of all grades under the chief.

It appears to us that the better system of classification would be something like this:

Assistant Engineer; applicable to those only who are not in direct or responsible charge of any part of the work, but act merely under orders.

Resident Engineer; those in charge of the primary sub-divisions of the work, termed residencies, which may be from 2 to 20 miles in length, according to the magnitude and difficulty of the work.

Division Engineer; those in charge of a division composed of several residencies. When the work is not of such magnitude as to require cutting up work into divisions, this title not to be used at all, but the resident engineer may act directly under the chief and the principal assistant if any. On the other hand, in maintenance or operating positions, or when the work is so slowly pushed as not to make it expedient to subdivide into residencies, while yet an engineer is needed of such qualifications and experience as to be fully competent to take charge of several residencies if such subdivision were necessary, the title to Division Engineer only need be used.

This is not at all an uncommon case in practice, and there would be an injustice in requiring a man who may have charge of 50 to 100 miles of line in construction, or even more in maintenance, with several assistants under him, to be designated by an inferior title merely because his work was not so actively pushed as to need subdivision into residencies.

Principal Assistant Engineer, or Assistant Chief Engineer; an officer of *coördinate* jurisdiction with the chief, and authorized to represent him in his absence over the whole work under his charge either in all respects or in some special part of the work, as location, construction, bridge-work, etc. This term not to be used, but Division Engineer only, when the work is sub-divided into two or more geographical divisions, each under a separate engineer reporting directly to the chief.

By this classification the title Division Engineer becomes of almost coequal importance with that of Principal Assistant, as it should, because the former has a more direct if less extended responsibility. There are even cases, as conspicuously in Mexico, where the exigencies and magnitude of the work require placing Division Engineers in charge of 200 to 400 miles of mixed location and construction, with headquarters at a great distance in time from the Chief, and with a responsibility even greater than ordinarily attaches to the position of Chief Engineer. The case is still stronger when, as happened in Mexico, the Division Engineer has to control some thousands of workmen directly, and pay out large sums of money. In this case equity would suggest the title of Chief Engineer of Division, although few Engineers-in-chief are disposed to favor such a title unless they have themselves the title of General Manager or Assistant General Manager, as was the case on one road in Mexico, which thus found room for four independent "Chief Engineers." But however convenient such a subterfuge in special exigencies, it is not one which engineers can or ought to approve of. The title of Chief Engineer should be in fact what it is in form.

This brings up another abuse of engineering titles, that of "Consulting Engineer." Perhaps no title has been more severely twisted from its proper signification to serve special ends, as notably to put some one in fact, but not in form, over the head of a Chief Engineer, so as to avoid wounding his sensibilities. A Consulting Engineer, properly so called, is one called in *by the Chief Engineer*, or at his desire and request, to give his advice to the Chief for a consideration, for what it is worth, and for the latter to accept or reject as he pleases. It is really not professional for anyone to accept the position of Consulting Engineer on any other terms or in any other way, as was well illustrated by the famous engineer Major WHISTLER, who went to Russia in the early days of railroading to build the line to Moscow. The Czar instructed him one day to go and take a look over the work on certain fortifications, and tell him what he thought of it. "Does this request come from the engineer?" asked WHISTLER. "Oh, never mind him," said the Czar, "I want to know if he is doing his work well." "Your Majesty," remarked WHISTLER, "in my country it is not customary to report on work in charge of another engineer except to the engineer himself," and refused point blank to go. We do not vouch for the exact words, but the anecdote is authentic.

The very fact of calling in a Consulting Engineer, however, admits that he may know more than the Chief, and hence it is in a sense a higher engineering title, although it is also a lower one, in its only legitimate sense, since the final discretion still rests with the Chief. It has often been used, however, to put a man in effect over a Chief Engineer, as was absurdly illustrated on the Cincinnati Southern Railway, where the brand-new title of "Consulting and Principal Engineer" was invented for the real Chief Engineer for reasons needless to go into. It is to be regretted that there is no sufficiently well established code of professional ethics in engineering to make such misuse of terms impossible. A Consulting Engineer, properly so called, can only become such at the express desire and request of the Chief. When put over his head in any way by a higher power than either, to prepare plans for the "Chief" to carry out "willy-nilly" or to criticize and suggest changes in his work *to any one but the Chief himself*, both are placed in a position which we cannot look on as consistent with professional propriety.

It is not likely that the newly appointed committee will give any consideration to this latter question, since it is outside of their instructions, but we hope they will at least bring order out of chaos in the titles of the junior engineering grades.

CORRESPONDENCE.

"A Happy New Year."

The St. Louis, Arkansas & Texas Ry.
TEXARKANA, Tex., Jan. 12, 1888.

EDITOR ENGINEERING NEWS:

Herewith please find a blue print copy of a design which I made about Dec. 19, and mailed to various professional brethren.

By comparison you will find that it bears a most remarkable resemblance in point of idea and detail even, to a cut published in your issue of Jan. 7, 1888.

So striking indeed is the similarity that I am anxious to become better acquainted with one whose mind, only a week or so later, should lead in the same channel as my own, and will be obliged if you will favor me with his name and address.

Very truly yours, F. S. INGOLDSBY,
Resident Engineer.

[Our correspondent's letter enables us to make an acknowledgement before impossible. One of the blue prints to which he refers found its way into our office and was the basis of our artist's design, though the two differ essentially in treatment. Coming as it did without name, we gave no credit for the suggestion, but now do so heartily.—ED. ENG. NEWS].

Rate of Rain-Fall Records

Signal Office, War Department.
WASHINGTON, D. C., Jan. 5, 1888.

EDITOR ENGINEERING NEWS:

Please find enclosed advance copy of a small portion of the November Weather Review, which treats in the manner suggested by the engineers of the country, as understood by the Chief Signal Officer, the question of heavy rainfalls. The records of the self-recording gauges have been carefully examined with the results shown herewith.

The Chief Signal Officer has written the director of the Meteorological Observatory at New York, and also Mr. ROTCH, Blue Hill Observatory, near Boston, Massachusetts, with the view of supplementing the discussion of rainfall at Washington City by similar treatment of the data obtained from these observatories. I am, very respectfully,

Your obedient servant, A. W. GREELY.
Chief Signal Officer.

[We reprint below in full the very interesting abstract enclosed by Gen. GREELY, to whom the engineers of the country are greatly indebted for the intelligent interest he has shown in extending the work of the Signal Office to include this class of records. The record below for Washington is a very complete and interesting one. Let there be similar records for 50 or 100 other points throughout the country, and there would be sufficient data for nearly exact predictions as to what might be expected in the way of heavy rainfalls at any point not subject to peculiar climatic conditions.—ED. ENG. NEWS.]

HEAVY RAINFALLS AT WASHINGTON CITY.

In connection with a request from the superintendent of sewers for certain information regarding

rainfall in Washington City, a considerable amount of data has been gathered, a partial discussion of which may be of interest to engineers throughout the country. The observations cover a period of 17 years (less one month), from January, 1871, to November 30, 1887; in which time rain or melted snow has been recorded 1,543 times. The rainfall has exceeded 1 in. 192 times, or almost exactly once in 8 times. On 37 different occasions (about 2¼ per cent.) the amount of rain during the storm has equalled or exceeded 2 ins. Rainfalls exceeding 2 ins. occurred 4 times in August, and 6 times each in June, July, September and October; while they were rare in other months; none at all having been observed in February. The heaviest rainfall from a single storm was 5.80 ins. in nineteen hours on July 29 and 30, 1878.

Of equal and perhaps greater importance than the amount recorded during a single storm, is the rate which falls in any single hour. Assuming that a less rate than 1 in. per hour is not especially important, examination was confined to those cases in which the rate was greater. 16 cases have occured, as shown in the table below:

Heaviest falls of rain at Washington City, from January 1871, to November, 1887, inclusive.

Date.	Amt.	Time.	Rate of fall.	
			Per hour.	Maximum rate at any time.
	Inches	h. m.	Inches	Inches.
July 3, 1871.	1.13	0 30	2.26	2·26
July 18, 1871.	0.83	0 20	2·49	2·49
Sept. 25, 1872.	1.50	1 00	1·50	8·00
Aug. 18, 1875.	1.20	1 00	1·20	2.40
Aug. 29, 1875.	1.30	1 00	1.30	1.30
Oct. 23, 1875.	1.40	1 00	1·40	2·50
June 22, 1877.	1·08	1 00	1·08	2·00
July 28, 1877.	1·20	1 00	1·20	3·00
July 29, 1877.	1.42	0 26	3·24	3·24
Oct. 4, 1877.	1.49	1 00	1·49	6.00
July 2, 1884.	1·12	1 00	1·12	3·00
Nov. 24, 1884.	1.00	1 00	1·00	2·00
July 26, 1885.	0·96	0 05	9.60	9·60
Oct. 29, 1885.	1.20	1 00	1·20	2.40
June 24, 1886.	1.10	1 00	1·10	3.00
July 26, 1886.	1·80	1 00	1·80	6.10

Thus it appears that on two occasions, Sept. 25, 1872, and Oct. 4, 1877, 1.50 ins. fell in 1 hour.

Perhaps, however, the more important and destructive results followed from the storm on July 26, 1886, when a rainfall of 1.80 ins. occurred in one hour.

An examination of the records of the self-registering rain gauge proved that the rate of rainfall for short periods of time far exceeds the rate per hour.

As, for instance, on Oct. 4, 1877, and July 26, 1886, the rate equalled 6 ins. per hour, and on Sept. 25, 1872, 8 ins. per hour. The maximum rate recorded, however, was the extraordinary one of 9.60 per hour, which occurred on July, 26, 1885, when .96 in. of rain fell in 6 minutes.

It is possible that these data may be of marked value to engineers in showing that the occasions are very rare in Washington, and probably in adjacent cities, when more than an inch and a quarter of rain may be expected within an hour.

Unsymmetrical Sections.

Sheffield Scientific School of Yale College.
NEW HAVEN, Conn. Jan. 9, 1888.

EDITOR ENGINEERING NEWS:

I regret in my turn that I have not been able apparently to clear up the "obscurity" involved in the issue between Mr. JOHNSON and myself. I would like to try once more.

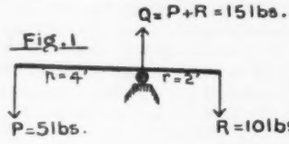
I will quote the principles laid down by Mr. JOHNSON, putting in brackets and italics the words which ought to be supplied to make them correct, and without which they are incorrect.

"*First.* Equilibrium can exist from equality of forces [*when such equality is the sole and efficient condition*] only when the opposing forces lie in one and the same straight line, or are so arranged about common centers that their resultants lie in one and the same straight line. In the latter case the resultants must be equal, though the actual forces need not be."

"*Second.* When parallel forces act at different distances from a common center or axis, equilibrium can not result from equality of forces [*as the sole and sufficient condition*] but is only possible when the moments of these forces are [*also*] equal.

In other words when any number of forces acting upon a body at different points and in different directions, hold the body in equilibrium, three conditions must always be simultaneously fulfilled. (1). The forces must balance horizontally. (2). They must balance vertically. (3). The moments must be equal about any point. If the first only is ful filled, the body will move up or down, and at the same time revolve. If the first two only are fulfilled, the body will revolve. If none are fulfilled, the body will revolve until the resultants are in the same straight line, and it will then travel in the direction of the greater. In every case of equilibrium all three conditions are always fulfilled.

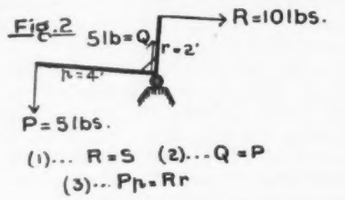
In Fig. 1. we have a simple lever. When equilibrium occurs we have (1) $o = o$, (2) $Q = P + R$, (3) $Pp = Rr$. The first two conditions are necessarily fulfilled by the construction, since the pressure upon



(1)··· $o = o$ (2) ··· $Q = P + R$
(3)·· $Pr = Rr$

the fulcrum must always be the sum of the other two forces, and there are no horizontal forces. Hence the third condition is the sole remaining one to be fulfilled.

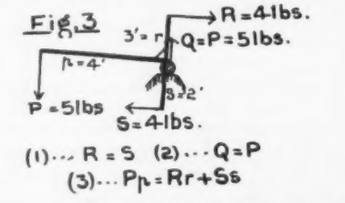
In Fig. 2. suppose the same lever put up at right angles. Here only the second condition is necessarily fulfilled, viz., $Q = P$, since the pressure upon the fulcrum must equal the dormant force P. To prevent rotation we must now have also, $Pp = Rr$.



(1)··· $R = S$ (2)···$Q = P$
(3)·· $Pr = Rr$

But these two are not sufficient. Unless we introduce a new force S from outside, and make $S = R$, we shall have horizontal motion.

In Fig. 3, suppose we have a lever with an arm above and an arm below. Here again only the second condition is necessarily fulfilled, viz., $Q = P$.



(1)··· $R = S$ (2)···$Q = P$
(3)··· $Pr = Rr + Ss$

To prevent rotation we must also have $Pp = Rr + Ss$, and also $R = S$, otherwise we should have motion as in Fig. 2.

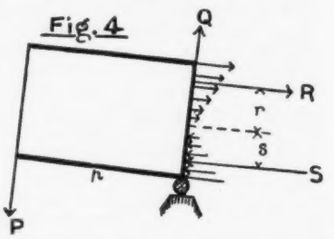
Now suppose a beam supported upon a fulcrum at the center, and with an equal weight P, at each end, and let us cut this beam in two at the fulcrum and take away the right hand half. If we replace each cut fiber above the axis by a tensile force, and each cut fiber below by a compressive force and have these forces the same as before the fibers were cut, there is still equilibrium, and we have Fig. 4. We can replace all the fibers above the axis by the resultant R, and all below by the resultant S. The case now becomes exactly the same as Fig. 3. We have necessarily $Q = P$. We must also have the moments $Pp = Rr + Ss$. *We must also have* $R = S$. That is the sum of the forces above and below the neutral axis must be equal, *no matter where the neutral axis is.*

It is a well known principle of statics, that a "couple," *i. e.*, two equal parallel and opposite forces, can only be held in equilibrium by another couple. Also that the moment of a couple about any point is constant and equal to either force in to the distance between. If then in any case of equilibrium, two of the forces form a couple, all the others must reduce to another couple whose moment is equal and opposite. This single condition applies to all the cases we have illustrated. In Fig. 4, two of the forces, *viz.:* P and $Q = P$, are parallel, equal and opposite. They, therefore, form a couple whose moment at any point is Pp. Then all the other forces must reduce to a couple R and $S = R$, whose moment $R(r + s)$ or $Rr + Ss$, must be equal and opposite.

Is it not plain Mr. Editor, that *no matter where the neutral axis is*, this much is certain, that the sum of the fibre forces above and below must always be equal, or there is no equilibrium? Yet this is the condition which Mr. JOHNSON calls "false statics."

Now balance a triangle on its centre of gravity and the force of gravity on any square inch is the same all over. The moment of the gravity force then is a constant into the distance from the axis. If we assume that the fibre force at any point increases directly with the distance from the axis, that point which balances the moments of the gravity forces will balance the fibre forces themselves. This point is the center of gravity. The neutral axis then for all sections, passes through the center of gravity, as I asserted in my previous letter, provided we have plane sections after flexure, fibre forces increasing with the distance, and the limit of elasticity is not exceeded. Mr. JOHNSON says distinctly in his letter that he accepts all these conditions. That is just his mistake. He cannot consistently accept these conditions and move the neutral axis away from the center of gravity.

Referring to Fig. 4. Mr. JOHNSON has distinctly asserted in a previous letter that the neutral axis equates the moments of the fibre forces or $Rr = Ss$.



(1)··· $R = S$ (2)··· $Q = P$
(3)··· $Pr = Rr + Ss$.

Prof. J. B. JOHNSON called his attention to the fact. I have proved above that R and S must be equal. Hence r and s must be equal. But this would take the neutral axis for an unsymmetrical section away from the centre of gravity, and this cannot be done if we accept the conditions which Mr. JOHNSON says he *does accept*. Here is the issue and the "obscurity" as I see it.

Now the error of Mr. JOHNSON as I look at it, and as I pointed out in my previous letter, is in concluding from certain experiments that the received theory of flexure is at fault, and while he accepts the promises of the received theory, denying its conclusions, and asserting that the second condition of equilibrium is "false statics." He seems to think that "all acknowledged authorities assert or imply, that the neutral axis is, in all cases, upon a line which passes through the center of gravity." I do not think this the fact however. No authority known to me, claims this even by implication. They do claim that this is the position of the neutral axis for all cases *where the limit of elasticity is not exceeded*, and they claim rightly that experiment justifies the results of theory where this condition is not isolated. They all without an exception known to me at least, explicitly specify this condition. There is no theoretical formula for breaking weight or modulus of rupture. Theory gives accurately deflection and load, and fibre strain for all sections, provided the limit of elasticity is not exceeded. It gives nothing at all for *rupture*, where this limit is exceeded.

If Mr. JOHNSON can establish by experiment in any case, that at or near rupture the neutral axis has the position he claims, well and good. But when established that will prove, not that the accepted theory is wrong, or that statical principles have been incorrectly applied by those who should understand them, but it would prove that elonga-

tion at the point of rupture is no longer directly as the force, which we already know to be quite true, and also either that plane sections do not remain plane after flexure, or else that the fibre force varies as the square of the distance. One or the other of these consequences must be the inevitable result, and no authority I ever saw or read is prepared to decide which, or to deny either.

The accepted formula for rupture for a semi-beam, $P = \frac{R\,I}{v}$, is empirical. Its form only is taken from theory. At the breaking point we find, as we know we ought to find, that theory has nothing to say, because the conditions have been violated upon which the theory is based. It is entirely open to any one to give R or v, or both, any values or sets of values which best accord with experiment or give a more comprehensive formula. If the value of v, recommended by the "Pencoyd Pocket-book" will give for unsymmetric sections the same value of R as for symmetric, it may be well to adopt it *for rupture*. It is quite as philosophic, however, to keep v constant and change R. It is simply a question of how best to conform an empirical formula to experiments. The "Pencoyd Pocket-book" correctly states that the axis must be "so located that the forces producing tension and compression are in equilibrium." This, as we have seen, must *always* be the case. If Mr. JOHNSON wishes to introduce *in addition* to this and the other two necessary conditions of equilibrium, his condition of equal moments above and below the axis also, and stands on the perfectly tenable ground that *for rupture* the section either is not plane after flexure, or else the fibre forces are not as the distances, he can do so without producing any discussion except as to the fact. The accepted formula for rupture is always open to amendment, even if we have to change its form or add another term to make it accord with experiment. If he will simply preface my foot note with the words, "at the *point of rupture*, this is not strictly correct," he will have all he needs and all I contended for.

But in any case, whether we change R or v, or get up another formula, whether the elastic limit is or is not exceeded, he can rely upon it that if there is equilibrium, wherever the neutral axis may be, the sum of the fiber forces above and below will always be equal, and also that so long as the elastic limit is not exceeded and the section remains plane after flexure, the neutral axis will pass through the center of gravity *because* their sums are equal. Mr. JOHNSON accepts for the point of rupture the premises of theory which are only true within the elastic limit, and thereby violates the general conditions of equilibrium which must always be fulfilled; whereas he should accept these conditions and alter the premises.

A. J. DUBOIS.

The Harlem Depressed Tracks: Correction.

N. Y. Cent. & Hudson River R. R. Co.,
Chief Engineer's Office.

NEW YORK, Jan. 14, 1888.

EDITOR ENGINEERING NEWS:

I notice two errors in your note on page 19 of this day's issue of ENGINEERING NEWS, in regard to the depression of the Harlem tracks of this company One is that "the track is to be depressed about 10 ft. from 138th street to Woodlawn." The error here is that the depression commences at 144th street, instead of 138th street, and terminates at Glencoe street, (between Jerome Park and Williams Bridge Stations instead of *Woodlawn*. The second error is in the amount of depression. The *average depth* of depression over this distance is just about 7 ft., the *maximum*, 12 ft. at 173rd street. There are also only 23 bridges to be built, instead of 38, as stated.

Yours truly, WALTER KATTÉ
Chief Engineer.

[It appears we trusted too much to the correctness of a detailed newspaper account.—ED. ENG. NEWS.]

The Southern Pacific "Straight Air" Accident.

ROCHESTER, N. Y., Jan. 14, 1888.

EDITOR ENGINEERING NEWS.

On Saturday Dec. 24, 1887, before the late catastrophe, the Southern Pacific passenger train leaving Mojave, about 10 A. M., broke in two about halfway up the eastern side of the Tehachepi Pass grade, the rear cars were stopped by the newsman. After the train was coupled up, and perhaps 20 minutes after leaving the point of our first accident, the train parted again at the same car, an old Pullman, carded as "received in bad order." The rear cars were stopped by the newsman with the help of some of the passengers.

Upon inquiry I found that the Southern Pacific road does not use automatic air brakes, but only "straight air." As this appeared to me wrong, I called at your office as soon as I returned to New York, (Jan. 5), and made a verbal statement of the case to you, saying that the public ought to be warned.

The accident was repeated Jan. 10. I enclose you two accounts of it, one says several were killed or burned. The second account is so odd that I cannot understand it; note the words italicised.

I hope you will take up the case. I for one shall be glad to furnish you a list of the roads in my territory that are not equipped with safe brakes. Ought not the Southern Pacific to be punished?

Yours,

CHARLES E. WEBSTER.

[In our issue of Jan. 7, following the interview referred to, we published an editorial note expressing amazement at the continued use of inferior brakes on a road which had suffered from them so severely, and in our following issue of Jan. 14, were unhappily enabled to note in an editorial the "Quick Confirmation" which the accident Jan. 10 gave as to that danger, as well as the Bradford accident in Massachusetts as to the danger of using inferior bridge floors, on which we had commented, the week before. The Southern Pacific certainly does deserve punishment, for they have sinned knowingly, but in some future Bradford affair the guilty parties will be able to plead the recommendations of the State Railroad Commission for inferior practice. ED. ENG. NEWS.]

PERSONAL.

EDGAR BERRYMAN, Chief Engineer and Superintendent of the Montreal & Sorel Railway has been appointed Chief Engineer of the Great Eastern Railway, with headquarters at Montreal. He will resign the position of Superintendent, but retain that of Chief Engineer of the Montreal & Sorel Ry.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The Annual Meeting was held at the house of the Society on Jan. 18, President WM. E. WORTHEN in the chair.

The Secretary read the report of the Board of Direction, as follows:

REPORT OF THE BOARD OF DIRECTION FOR THE YEAR ENDING DECEMBER 31st, 1887.

Membership.

As shown by the tabular statement hereinafter given there has been, during the year an addition of 116 to the various grades of Society membership. In this nominal addition of 116 there are two former Associates transferred to Members, and 9 former Juniors also transferred to Members: therefore the actual new additions to the Society membership during the year, number 105.

The losses from the Society membership have been 14, being 11 by death, and 3 by resignation. The number of persons now connected with the Society is 1,110, being greater by 91 that at the end of the previous year.

The actual net increase during the year, and present total in each class of membership, are:

Hon. Mem., decrease during year,	1,	Total,	8
Corresponding Members,			3
Members, increase during year,	78,	"	838
Associates, " "	1,	"	45
Juniors, " "	14,	"	120
Fellows, not included above, decrease,	1,	Total,	56
Subscribers to the Building Fund, not included above	40,	"	40
Increase during year,	91.	Total,	1,110.

Tables showing the classification of membership at the beginning of the year, and the changes during the year, are given at a subsequent part of this report.

Annual Convention.

The Annual Convention was held at the Hotel Kaaterskill, Catskill Mountains, N. Y., July 2d, 4th, 6th, and 7th, 1887.

The proceedings at the Convention have been published in detail in the Proceedings for that month. Members of the Society assembled at the rooms on the evening of the 30th of June, and on the next morning, July 1st, proceeded by steamer up the Hudson River to Rondout, and thence, by rail, to the hotel. There was a large attendance at the Convention. A number of interesting papers were presented, and the discussions, both on technical subjects and at the business meeting, were animated. During the Convention visits were made to the bridge in progress of erection over the Hudson River at Poughkeepsie, and to the Cement Mines and Works at Binnewater, Ulster County, N. Y.

The suggestions made by Members as to a desirable place for the next Convention, and an invitation which has been tendered to the Society, will be presented at the present meeting for your consideration.

Meetings of the Society.

Nineteen meetings of the Society were held during the year, one of which was the Annual Meeting, held in New York, January 19th and 20th, and another the Annual Convention, held at the Hotel Kaaterskill, N. Y., July, 2d, 4th, 6th and 7th, all the sessions of the Convention, including the business meeting, being counted as one meeting of the Society. Meetings have been held on the first and third Wednesday of each month, except July and August.

Thirteen meetings of the Board of Direction have been held during the year.

Light collations, provided entirely by subscription of Resident Members, have followed the Society meetings, and have given opportunities for conversation which have been appreciated.

Transaction.

The number of pages issued in the Transactions is now increasing to such an extent that it has been determined to make the volumes include six months, instead of 12 as heretofore. This will make the Transactions much more easily bound and handled, as the 1035 pages of last year were found to be too bulky for convenient reference and use.

The Society House and Building Fund.

At an informal meeting held at the Hotel Kaaterskill on July 4th, 1887, at which a number of members of the Society were present, the President, Mr. WILLIAM E. WORTHEN, stated that the Society had grown to such extent that the present House had become inadequate, particularly for the meetings, and for the convenient use of the Library, and that it was of great importance to the welfare of the Society that something should be done either towards building an addition to the present house, or, if it were practicable, the purchase of larger and more commodious quarters.

The following resolutions were adopted:

Whereas, the accommodation of the present Society building is entirely inadequate for the purposes of the Society, and it is deemed advisable without delay either to provide new quarters or an enlargement of the present building:

Resolved, That the members and friends of the Society are urged to contribute to the Building Fund as they may be able in order that immediate measures may be taken by the Board to accomplish this object.

Resolved, That the Board in its discretion may expend a reasonable sum in an addition to the present building.

The sum of $5,225 was directly subscribed by gentlemen present; and subsequent subscriptions have been received, making the total amount $9,169.50.

The Board of Direction, in view of the extent of this subscription and of the fact that it exceeded the amount estimated as necessary to make an enlargement of the present house, determined to appoint a committee with reference to ascertaining whether an amount could not be secured from among persons connected with engineering interests to warrant the purchase or erection of a larger building for the Society. This committee has entered upon its duties and will be able to report at the next Convention of the Society.

Subject of the Appointment of a Committee on Technical Education and Professional Training.

At the last Convention of the Society the following resolution was adopted:

"*Resolved*, That the Board of Directon of the Society be requested to consider the advisability of appointing a standing committee on Technical Education and Professional Training, which should annually report to the Society the status and progress of such instruction in the United States, and Europe as well, together with such data, statistics and suggestions relative to the subject as may seem to them proper, said committee to coöperate with similar committees of other engineering societies, should such be appointed."

In discussing the proposition thus submitted to the Board, it is necessary to consider the aims and objects of the Society, and the proper scope of investigations which may be undertaken under its direction and at its expense.

Out of the infinite variety of subjects which interest Civil Engineers, it is evident that only a limited number can be critically examined and discussed by, and at the expense of this organization, which includes specialists in almost every branch of the profession. It appears to the Board that in selecting topics for discussion and papers for printing, preference should be given to subjects which will be of interest and profit to Engineers who have had such experience and made such advances in their profession that they are qualified to criticise methods of overcoming difficulties and solving novel points of practice.

Whatever the ultimate scope of the Society's work may be, it must always be borne in mind that the object of its formation, and the aim of its present existence is not primary education in science, but the higher education of skilled scientists.

As its funds available for the dissemination of scientific knowledge increase, opportunity will be afforded for extension of the scope of its publications so as to include, possibly, the consideration of the best methods of primary education.

But at this time primary or rudimentary education is not its object, and will not be so long as it remains devoted to the objects and aims of its founders and, we believe, the great majority of its present members.

The Board does not consider it advisable therefore to take any action which would lead to the expenditure of the Society funds in discussing the early education of engineers so long prior to the time when they can under any circumstances, become members of the Society.

Amendments to the Constitution.

No amendments to the Constitution have been adopted during the year.

A number of amendments have been regularly presented and are before you for discussion and amendment at the present Annual Meeting.

The Norman Medal.

The Norman Medal for the year 1886 was awarded to Paper No. 318, "English and American Railroads Compared," by EDWARD BATES DORSEY, M. Am. Soc. C. E

The Board of Censors to award this medal for the past year will present its report at the present meeting.

The Rowland Prize.

The Rowland Prize for the year 1886 was awarded to Paper No. 317, "The Cantilever Bridge at Niagara Falls," by C. C. SCHNEIDER, M. Am. Soc. C. E.

The Committee to award this prize for the past year will present its report at the present meeting.

Membership Tables.

The following tables show the changes and additions during the year in the various classes of membership: [The substance is given on our editorial page].

The additions during the past year to the several classes of Society membership have been:

Members qualified	86
" reinstated	1
Associates qualified	3
Juniors qualified	25
Fellows qualified	1
Total additions	116

The decrease during the year in the several classes of membership has been:

Honorary Members, Died 1	1
Members, Died 6, Resigned 3	9
Associates, Transferred to Members	2
Juniors, Died 2, Transferred to Members 9	11
Fellows, Died 2	2

Totals: Deaths 11; Resignation 3; Transferred 11; 25

There has been an addition of 116 to the various classes of membership and a decrease of 25, making the actual net additions during the year 91 in number.

On January 1st, 1887 there were, as stated in the last Annual Report, 29 proposals pending. One hundred and seventy-six proposals have been received during the year; 87 candidates have been elected Members, of whom 2 were transferred from Associate and 8 were transferred from Juniors; 3 candidates have been elected as Associates; 28 candidates have been elected Juniors; 1 candidate has been elected a Fellow.

Eighty-six persons have during the year qualified as Members; 3 have qualified as Associates; 25 have qualified as Juniors; 1 has qualified as Fellow, 7 candidates elected during the year as Members, and 4 as Juniors have not qualified. There are 56 proposals now pending.

The Library has been increased during the year by the following additions:

Books and Pamphlets	526
Maps, Plans, Drawings, Charts, Photographs and Engravings	131

The Society has lost by death during the term covered by this report six Members:

Messrs. JAMES B. EADS, Past Vice President, and who was also a Fellow of the Society, and a Subscriber to Building Fund, F. W. VAUGHAN, Past Director of the Society, WILLIAM W. WILSON, EUGENE F. FALCONNET, SULLIVAN HASLETT, STEWART DERBISHIRE; 2 Juniors, Messrs. A. J. STAKLBERG and FRANK BERESFORD 2 Fellows, Messrs. FRED KRUPP and ALEXANDER MITCHELL.

Respectfully submitted,
For the Board of Direction,
JOHN BOGART, *Secretary.*

The report of the Treasurer was as follows:

REPORT OF THE TREASURER.

Receipts.

Balance on hand, Dec. 31, 1886:			
Building Fund	$ 100.00		
General Funds	3,838.02		
			$ 3,938.02
Entrance Fees		$ 2,875.00	
Dues	$10,802.26		
Past Dues	1,070.00		
Dues for Year Beginning Jan. 1, '88	1,290.11		
		$13,162.37	
From Sales of Publications		780.07	
" Certificates of Mem'p.		126.00	
" Advertisements		429.75	
" Interest on Fellow'p:			
" Fund Bonds	$480.00		
" Int. on Savings Bank Deposit	53.80		
" " Norman M'l Fund	70.00		
" " Rowland Prize "	60.00		
" " Gen. Fund Stock	40.00		
" " Gen. Fund Bonds	60.00		
" " Compounding Fund Bonds	60.00		
		823.80	
From Fellowship Fees		150.00	
Subscription to Fund for Enlarged Bld'g		6,169.50	
Compounding Payments		500.00	
Other Sources		44.30	27,020.79
			$30,958.81

Disbursements.

Interest on Mortgage		$ 800.00	
Taxes		471.15	
Publications		8,011.03	
Stationery and Printing		969.90	
Postage		1,264.89	
Library		797.37	
Salaries		3,000.00	
Convention and Annual Meeting		1 597.95	
Janitor, House Supplies, Fuel, Water and Gas		1,867.78	
Certificates of Membership		58.25	
Insurance		244.63	
Norman Medal and Rowland Prize		120.50	
Finance-Treasurer's Books		1,150.00	
Work of Committee		370.00	
From Building Fund—Permanent Repairs		100.00	
Other Expenditures		441.23	
			$21,264.68
Purchase of Bond, Building Fund			1 035.00
			$22,299.68
Balance on Hand:			
Building Fund	$5,134.50		
General Funds	3,524.63		8,659.13
			$30,958.81

With regard to the place at which the next convention shall be held numerous suggestions were made. An invitation was read from the mayor of Milwaukee, Wis., and a number of members of the Society resident in that city, also a letter from City Engineer, BENZENBERG, inviting the Society to meet there. On motion it was resolved, with only one negative vote, that the invitation be accepted, and the convention held at Milwaukee, Wis., the date to be fixed by the Board of Direction.

The Committee on Uniform Standard Time reported that the 24 hour system is making satisfactory progress. It has been adopted on 2,600 miles of the Canadian Pacific Ry., and will gradually be extended over the whole of that system; it has also been adopted on sections of the Canadian Government railways and other lines in this continent, on some European lines, and in Japan. Several letters were read highly commendatory of this system. In order to educate the public mind to this system, a movement is on foot to have it adopted and explained in the public schools of the United States and Canada. The following were the answers to questions issued in a circular by the committee:

1. Are you in favor of adopting the 24 hour system, abandoning a. m. and p. m?
   Affirmative; 61 railroads; 35,645 miles.
   Negative; 38 " 26,572 "

2. Are you willing to adopt this system for employee's time tables if your connecting lines do?
   Affirmative; 76 railroads; 47,004 miles.
   Negative; 21 " 20,109 "

3. Is it necessary for the people along the line to adopt this system before your road adopts it?
   Affirmative; 37 railroads; 22,529 miles.
   Negative; 49 " 26.110 "

4. Will the people generally adopt it if you do?
   Affirmative; 25 railroads; 11,436 miles.
   Negative; 49 " 34,594 "

5. Do you think it practicable to bring about this change at the present time?
   Affirmative; 38 railroads; 25,435 miles.
   Negative; 44 " 33,843

The Committee on Joint Library reported that no satisfactory progress had been made, and that there was not encouragement enough to ask for the continuance of the committee. It was moved and seconded that the committee be discharged. The Committee on the Relation to each other of the form of Railway Wheels and Rails reported that it had been prevented by various causes from having its report ready as soon as expected, but had collected a large amount of material therefore. It was on motion continued.

Some discussion then ensued upon a question as to the standing of "Resident," "Division" and "Assistant" engineers. There is at present no uniformity; in some cases the Assistant Engineer being the highest grade next to the Chief Engineer and in other cases being the lowest grade.

The proposed amendments of the Constitution of the Society then came up for discussion, and there was a long and sharp discussion over the proposition to create a "Student" grade. After much animated discussion (not to say wrangling) it was finally resolved to amend the amendments relating to the Student grade by striking out all reference to the change of name from Junior to Associate Member, and to let the amendment thus amended, go out for the letter ballot. Mr. MOORE advocated the reduction of Junior to a non-permanent grade, to last for only 10 years; the Juniors who were not elected to full membership within 10 years to be dropped out altogether. A large number of suggestions and alterations were offered but the final result was as above noted.

The meeting adjourned at 13.30 for lunch and reassembled at about 15 o'clock. WM. G. HAMILTON in the chair, and president elect THOMAS C. KEEFER with him on the platform.

The result of the canvass of votes for officers for the current year as follows:

President: THOMAS C. KEEFER, 264; scattering, 3

Vice-President; J. JAMES R. CROES, 261; scattering 6, ROBERT MOORE, 267.

Secretary and Librarian; JOHN BOGART, 258; scattering 9.

Treasurer; GEORGE S. GREENE, Jr., 263; scattering 4.

Directors; MENDES COHEN, 261; JOSEPH M. WILSON 262; STEVENSON TOWLE, 263; CHARLES B. BRUSH, 266; ALPHONSE FTELEY, 267; scattering, 16.

Mr. KEEFER made some brief but well choseen and loudly applauded remarks on his early professional experience on the Erie Canal and elsewhere, tracing his ancestry back in part to New Jersey, and in part to other nationalities, moving MR. HAMILTON to congratulate the Society on having so cosmopolitan a president.

The Committee on Compression of Cement reported its labors were not yet completed. F. COLLINGWOOD, Chairman, made some remarks respecting the different results obtained when different method of preparation were employed. The committee was continued.

R. HERING called attention to the desire of the Chief Officer of the Signal Department, that engineering societies should pass resolutions endorsing his application to Congress for a small appropriation ($2,000 or $3,000) for the purchase of automatic registering rain gauges. A suitable resolution was passed, and a committee appointed to take the matter in charge.

A committee was appointed to consider all the various amendments to the printed amendments and to unite them harmoniously; the committee to report at an adjourned meeting at 20 o'clock Jan. 19.

The meeting then adjourned.

In the evening a paper on "The Panama Canal in 1887" was read by Lieut C. ROGERS, U. S. N., before the society and invited guests in the hall of the Y. M. C. A. building on 23rd street.

Ohio Society of Surveyors and Civil Engineers.—At the meeting held at Columbus, O., on Jan. 11, the following papers were read: "Philosophy of Under Draining," by JONATHAN ARNETT, of London, O.; "Drainage," by F. M. KENNEDY, of Washington, O.; "Comparative Cost and Efficiency of Tile Drains and Open Ditches," by E. B. OPDYCKE, of Bryan; "Construction of Turnpikes," by G. S. INNIS, of Columbus. There were 24 new members elected. J. D. VARNEY, of Cleveland, O., was elected President, and Prof. C. N. BROWN, of Columbus, O., Secretary.

Engineers' Club of St. Louis.—284th meeting; Jan. 4, 1888. A paper by Mr. CHARLES H. LEDLIE, entitled, "Construction of Dam and Reservoir at Athens, Ga," was read by Prof. JOHNSON. The method of carrying out the work was given in detail, and sketches of the principal features were submitted. The protection of this kind of work against crawfish and musk rats was shown to be of prime importance. Col. MOORE, Messrs. HOLMAN, JOHNSON and FLAD took part in the discussion.

Prof. NIPHER read a paper on the "Volt, the Ohm the Ampere—What Are They?" being a mathematical discussion of the subject. The results were shown and their value to the electrical engineer explained. The paper was illustrated by suitable apparatus and drawings. Messrs. HOLMAN, FLAD, MOORE and SEDDON par-

ticipated in the discussion. Papers by N. W. EATES, and Prof. C. C. BROWN were announced for the next meeting, January 18th. W. H. BRYAN, *Secretary.*

Civil Engineers of Kansas.—At the adjourned annual meeting of the Civil Engineers of Kansas held in their Library, County Building, Wichita, Kan., on Dec. 3, '87, the following Officers were elected: J. C. HERRING, President; H. H. HENDERSHOT, Secretary; R. W. LUTTRELL, Librarian; H. H. JACKMAN, Treasurer and W. R. KESSLER and RANSOM H. BROWN, Members of the Executive Committee. OLIVER MULVEY, THOMAS A. BAYLEY, EDWARD M. BROWN, N. L. JACKSON, FRANK B. CLARK, J. B. HOFFMAN, WM. D. JONES, E. F. BATTE, COLIN R. WISE, C. B. THACHER, JOHN W. BEAR, and W. P. BIXBY were elected Members of the Association. Further additions to the Library being deemed necessary the matter was referred to the proper Committee.

The regular meeting, held Jan. 7, was presided over by H. H. JACKMAN. Discussion took place on the adoption of the conventional signs recommended by ENGINEERING NEWS in a recent issue, but as they did not cover the customary topographical signs, no action was taken. I. H. HATHAWAY, of Philadelphia, and A. M. JORDAN, of Atlantic City, were elected Members. The proposed plans of sewerage for Wichita, as designed by Rosewater & Christie, of Omaha, Neb., and the Pacific (West) System, received passing comment previous to an investigation to be made by the Sanitary Bureau of the Association.

The Association meets on the first and third Saturdays of each month. Interchange of proceedings with kindred associations is solicited.

H. H. HENDERSHOT, Secretary.

New England Railroad Club.—The meeting of Jan. 11, was called to order at 8 P. M., by President LAUDER, about 40 members and visitors being in attendance. The President announced the subject for the evening's discussion as "Frogs and Safety Switches," and called on Mr. GEO. RICHARDS, Master Mechanic of the Boston & Providence Railroad to open the subject.

Mr. RICHARDS said that the history of the switch was as old as that of railroading. The first switches generally used resembled the present switch used on street railways. Point switches were used on English railways 40 years ago. The first safety switch was a point switch, which was automatically held in position for the main line by a weighted bell crank lever. This was lifted by the switchman when the train was to be run upon the turnout. The weight turned the switch back into position for the main line as soon as the switchman released it. When the increase of traffic and demand for safety demanded the use of a safety switch in this country, the Wharton switch was introduced. While a good device in many respects, the lack of uniformity in wheel gauges has proved an insurmountable barrier to its general introduction. The White switch failed for a similar reason. Other forms with various merits and defects have been tried for a time, but the split switch has now come upon the scene, and like the mother-in-law with her trunk, it has probably come to stay. By safety switch I mean a split switch. It should be so arranged that it must be fully thrown one way or the other before the switch-stand can be closed. The use of three throw switches should be avoided. In laying out turnouts from the main line on a double track road more attention should be paid to the avoidance of leading [facing Ed.] switches. Nearly all the accidents commonly ascribed to broken flanges, loose wheels, and broken guard rails are caused by leading switches. The report that the accident near Haverhill, yesterday, was due to a leading switch should lead us to pay more attention to this matter.

Taking up the matter of frogs: the spring rail frog is to be recommended where the traffic is mostly on one side. Most of the failures in the use of the spring rail frog are due to its having too much motion. Riveted, bolted and clamped or keyed frogs all have their defects. With the first the rivets get loose. The rails of the bolted frog are liable to breakage through the bolt holes. Clamped frogs cannot be used with some forms of rail. Accidents whose cause is said to be unaccountable are sometimes due to having two frogs just opposite each other on the same line of rails. This should always be avoided by setting one frog a little in advance of the other. The whole question of frogs, switches and maintenance of way in general is made far more difficult by the rapid increase in the weight of rolling stock. I believe, however, that we have about reached the limit of engine weights, because we can get no more grate room between the wheels of our locomotives. The rolling stock is now too heavy in proportion to the weight of the rails. I believe we must soon come to the use of 100 lb. rails.

President LAUDER: I suppose a spring rail frog is the best device for the main line where the turnout is but little used.

Mr. PATCH, (Conn. River R. R.) On May 20, 1872, we put in our first spring rail frog. That frog has been in the track until day before yesterday when a wheel got off the track and tore things up around there; but I shall have it repaired and I think it will be good for five years more service at least. During the time the frog has been in use there has not been one cent expended upon it for maintenance. I believe that any other sort of frog in the same place would have been so worn out as to require to be renewed five times in the same number of years. We have now spring rail frogs in use about everywhere upon our main line, and I prefer them for almost any location. I don't consider them any more dangerous for a train to run over at high speeds than the solid rail.

W. E. CLARK (Vt. Valley R. R.). I think the condition of the tires has more to do with the wear of frogs than the weight of the engine. When a worn tire runs across the frog wings, the "outside flange" tends to crush a groove there.

President LAUDER: Engines that are heavy in proportion to their cylinder power have less tire wear than engines which weigh much less but are over-cylindered. We have just repaired the tires on a very heavy express engine whose mileage record shows $\frac{1}{10}$-in. of tire wear to 14,000 miles run.

J. S. LANE: (N. Y. N. H. & H. R. R.). We used to have split switches and spring rail frogs in use when I was railroading in Illinois in 1861, but they are so different from those in use now that I am afraid the latter would not be willing to claim relationship. In 1880 when I went on the New York, New Haven & Hartford road, there were but 3 spring rail frogs in use on the road. They are in the main line where all the fast New York expresses pass over them, and they are still in use and seem to be good for a life as long as that of the rail. We have about 300 split switches on the main line. I have several 3 throw facing split switches in use. I use guard rails on facing split switches.

Mr. MANSFIELD then gave a description of a movable guard rail for split switches which he had invented. A device which from his description seemed so thoroughly complicated that it would be reasonably sure to be out of order when the occasion came for its use.

Mr. W. H. ELLIS (Prov. & Worces. R. R.) then read a paper which he prefaced by saying that until road-masters could get all the split switches which they needed into their tracks, he thought it unwise to hinder their introduction by anything tending to increase their cost. In reference to frogs, cast-iron and wrought-iron frogs are certainly of the past. The proper flangeway is 1¼ in. Each frog should be lined up with a tangent at least 6 ft. long in front of the point. Various forms of safety switch have been and are in use, but the best opinion is now quite unanimous that the split switch is the safety switch for present use. A blue print was shown of the Boston & Albany standard split switch.

A recent accident on the Providence & Worcester has caused us to use cast steel braces instead of cast-iron. Guard rails are advisable where trains must run against the points. The objections to the use of split switches in snowy climate does not seem to be insurmountable.

The discussion then turned upon the relative advantages of a long and short wheel base for trucks, and there was quite an expression of opinion in favor of a longer wheel base, especially for four wheeled trucks, than has been the former practice. The matter of flanged or flangeless tires on a 6-wheeled truck was also discussed, and brought out quite prominently the fact that what suited on one road with easy curves did not suit at all on a road which was described as so "crooked that there were no curves on it, they were all square corners." The point regarding the limit to the weight of rolling stock mentioned in Mr. RICHARD'S paper was brought up by Prof. SWAIN (Mass. Inst. of Tech.) who thought some way would be found to get past this difficulty and that it was yet too soon to say when or where the increase in engine weights was to stop. After some further desultory discussion on this point and others suggested by it the club adjourned.

Canadian Society of Civil Engineers.—At the meeting of Jan. 2, the following officers were elected for the present year:—President, SAMUEL KEEFER: Vice Presidents, Col. GZOWSKI, E. P. HANNAFORD and H. F. PERLEY; Treasurer, H. WALLIS; Secretary, H. T. BOVEY. At the converzazione on the evening of Jan. 3, Mr. THOMAS C. KEEFER, the retiring President, delivered his annual address.

Engineer's Society of Western Pennsylvania.—The annual meeting was held at Pittsburg, Pa., Jan. 17, 1888, and the old officers re-elected as follows:—President, ALEXANDER DEMPSTER; Vice-President, W. L. Scaife; Directors, T. P. ROBERTS and CHARLES DAVIS; Treasurer, A. E. FROST; Secretary, S. M. WICKERSHAM.

THOS. J. BRAY, Supt. Tube Dept., Riverside Iron Works, Wheeling, W. Va., read a paper on "The Manufacture of Welded Steel Tubing," in which he claimed that the weld in steel pipe is much stronger than that in iron, especially in butt-welded pipe.

CONSTRUCTION NEWS.

Water.

Albany, N. Y.—The City Council has authorized the issue of the $150,000 bonds asked by the special water commission.

Newark, N. J.—During 1887 there were laid 190 ft. of 10-in., 20,140 ft. of 6-in., 1,022 ft. of 4-in., and 152 ft. of 3 in., an aggregate of 4¼ miles, bringing the pipe system up to 160¾ miles; 39 hydrants were set making a total of 1,341. The total amount of water pumped was 4,614,386,592 galls. at the Belleville station and 1,502,037,203 galls. at the high service station. An additional pump is recommended for the latter station. A new source of water supply is contemplated.

Springfield, Mass.—During 1887, 28,406 ft. of cast and wrought iron pipe were laid, 54 gates and 43 hydrants set. There are now 81 miles of pipe, 598 fire hydrants (70 being private) and 703 gates. The average daily consumption was 4,020,000 galls, or 100 galls. per head.

Baltimore, Md.—During 1887, 24¼ miles of mains were laid. Of this quantity 17¾ miles were laid in extending the mains for new supplies, etc., and were included in the regular work; and 6½ miles of mains of 20, 12 and 10-in. pipe, came under the head of special work, the cost coming out of the $1,000,000 loan. The cost of laying the 6½ miles of mains was $34,075.10. There was spent on account of Lake Clifton $80,923.40, making a total of $174,998.50 spent on account of the loan for the improvement of the water supply. The loan has not yet been issued, but some of the bonds are to be sold in the spring. The average quantity of water sent into the city daily during the year was about 35,000,000 galls. The Water Board has discussed the question of the new high service reservoir, which is to be built in the direction of Govanstown, but the exact site has not yet been selected. Work on the reservoir will hardly begin till the latter part of the year. The cost of the reservoir is to come out of the proposed loan.

Water-Works.—*Massachusetts.*—Ayer. The new water supply is in successful operation: the water is pumped to a distributing reservoir. The cost of the improvement is about $55,000.——Winchendon. A water supply is contemplated; estimated cost, $160,000.

New York.—Syracuse. The Salmon River Water Co., President WM. A. SWEET, will introduce a bill similar to the one defeated last year. It provides for bonding the city for not more than $3,000,000.——Jamaica. A water company has been incorporated by F. GROSJEAN, A. J. CORDIER, E. W. MARTIN, and others, and a franchise has been applied for. The company, which has a capital stock of $50,000, has works in operation at Woodhaven.——Jamaica. The water-works built by the Lockwood company were tested recently with satisfactory results. Three streams were thrown to a height of from 80 to 90 ft. by stand-pipe pressure, and 100 to 110 ft. by direct pressure. JOHN LOCKWOOD, of New York, is President.——Avon. The town has voted in favor of water-works, the supply to be obtained from Conesus lake.

New Jersey.—Orange. The Orange Water Co., which is supplying Bloomfield and East Orange, has elected the following officers: President, FREDERICK M. SHEPARD; Vice President, JOHN M. RANDALL; Treasurer, J. A. MINOTT; Secretary, F. M. SHEPARD, Jr.

Ohio.—Sidney. The city has voted to issue $60,000 in bonds for improving the water-works.

Virginia.—Warrenton. H. D. GARDEN, representing a New York firm, has made a proposition to establish water-works and an electric light plant.

Kentucky.—Ashland. A New York firm has made a proposition to build water-works. Address the mayor.

Georgia.—Cartersville. The Cartersville Land Co., incorporated by JOHN W. AIKIN and others, will establish water-works, gas works and electric light plant.

North Carolina.—Hendersonville. The city has voted to issue bonds for $20,000 for the construction of the water-works decided upon some time since.

Alabama.—Autaugaville. Water-works will be built by A. M. SMITH and JAMES NUNN.

Michigan Frankport. The town has voted to issue bonds for $10,000 for the construction of water-works.——Vassar. A succession of serious fires has roused the city to the need of water-works, but no system has yet been decided on by the City Council.

Illinois.—Staunton. The Board of Village Trustees will issue bonds for the construction of a reservoir.

Kansas.—Ness City. The city will soon vote on a proposition to issue $25,000 for a system of water-works.

Arkansas.—Pine Bluff. The Pine Bluff Water & Power Co. has been organized to succeed the Pine Bluff Water, Power & Light Co.

Missouri.—Jefferson City. The city has voted by a majority of 371 on a proposition to establish water-works and a franchise was awarded Jan. 10, to P. B. PERKINS, of Springfield, Mo. There will be 7 miles of main and 70 fire plugs. Annual rental, $3,000.

Nebraska.—Wahoo. Water was turned on Dec. 31. At present the mains extend only through the central portions of the city, but will be extended in the spring

California.—Santa Cruz. Action has been begun to serve an injunction to prevent the sale of the city water-works.

Texas.—Waco. C. W. WHITE, President of the Waco Water Co., has made a proposition for a contract with the city to succeed the one expiring in July next. Some objections have been raised, and the mayor considers some of the mains too small.—Greenville. The City Council, on Jan. 11, adopted a resolution unanimously accepting the proposition of the following-named capitalists to build water-works and furnish an inexhaustible supply of pure water: THOMAS E. TUTT, President of the Third National Bank, St. Louis, Mo.; R. C. KERENS; Vice President of the St. Louis, Arkansas & Texas R. R.; S. W. FORDYCE, President of the St. Louis, Arkansas & Texas R. R.; THOMAS HOWARD, Iron manufacturer, St Louis. JOHN W. HARRISON, iron manufacturer, St. Louis, GEO. A. MADILL, St. Louis; HENRY E. SCOTT, St. Louis; J. M. COOK and THOMAS KING, Greenville, Tex. The capitalists propose to send an expert hydraulic engineer at once upon the acceptance of their proposition to make the necessary survey and estimates.

Toronto, Canada.—The Committee on Works has finished its work for 1887. At the last meeting the committee decided to reconstruct certain sewers and proceed with other improvements. The Board's expenditure for the year was:

General purposes	$ 41,662.21
Roadways	34,996.15
Sidewalks	85,918.80
Local improvement	589,725.59
Specials services	144,738.89
Private drains	18,161.00
Total expenditure	$915,202.64
Expenditure for 1886	408,715.72
Increase	$506,486.92

47.71 miles of wooden sidewalks and 1.13 miles of stone and other walks were laid during the year. 15.38 miles of new roadway had been built, which includes 12.8 miles of cedar block pavement, the extension of street railway track keeping pace with the construction of improved roads. 16.14 miles of sewers and 1,584 private drains were put down.

Burlington, Ia.—The Burlington Water Co., which has been in operation since 1878, has now 20 miles of mains and 214 hydrants. The pumping plant consists of 3 engines with daily capacities of 3,000,000, 3,500,000 and 6,000,000 galls.

Lincoln, Neb.—During 1887 a sewerage system was completed upon modified Waring plans. The system comprises 20 miles of 6 to 24-in. vitrified pipe, with flush tanks and manholes. The total cost was $80,000. The amount for the above and storm water sewers paid during the year was $65,000.

Ashtabula, O., Water-Works.—The water is taken from Lake Erie by means of (1) a well, on sand beach, 25 ft. diameter, 10 ft. deep below water line, 200 feet from pump house and 350 ft. from shore line; (2) intercepting gallery 250 ft. long, running from the well towards the lake; (3) a siltwell 8 ft. diameter, 10 ft. deep at end of gallery and 100 ft. from shore line; (4) 4,000 ft. of 6-in. tile drains radiating from the siltwell so as to cover 500 ft. front on the lake, tiles laid from 4 to 6 ft. below water level. The water obtained is perfectly limpid and the capacity of the pumps is not sufficient to test the quantity. There are two Worthington compound, duplex, condensing, pumping engines, with a daily capacity each of 1,500,000 gallons, two Hazleton water tube boilers of 100 H. P. each, furnished by the Hazleton Boiler Co., of New York. The pump house is a brick building with cut stone trimmings, containing a pump chamber 22 ft. x 34 ft., boiler room 22 ft. x 34 ft., electric dynamo room 16 ft. x 22 ft., coal shed and work shop, and four living rooms for the engineer.

An electric light plant is run in connection with the water-works. There is one 80 H. P. automatic high speed engine, made by the New York Safety Steam Power Co., and two dynamos of 35 and 25 arc light capacity. The lights are 2,000 nominal candle power. There are 8 miles of wire. The stand-pipe is 20 ft. diameter and 100 ft high, on a hill 214 ft. above the lake level. It was made by Tippett & Wood, of Phillipsburg, N. J. The pipe system consists of 450 ft. of 14 in., 10,110 ft. of 12 in., 6,690 ft. of 10 in., 8,140 ft. of 8 in., 21,885 ft. of 6 in., and 7,000 ft. of 4 in. The pipe is of standard weight, made by the Cincinnati & Newport Foundry. There are 100 double nozzle, frost-proof hydrants and 29 valves, made by the Ludlow Valve Co., of Troy, N. Y. The contractors were Comegys & Lewis of 15 Cortland St., New York City.

S. W. LOCKETT was chief engineer and designed the works. E. J. SNOW, Genl. Manager and Superintendent of Construction. The works are owned and operated by the Ashtabula Water Co.; President, HENRY FAUETT; Secretary and Treasurer, J. W. MAGUIRE.

Brantford, Ont., Canada.—The Brantford City Water-Works Co. has submitted to the council propositions for the construction of new works and extensions for water supply for fire and domestic purposes. The works would be located at Holmedale and would have a daily capacity of 3,000,000 galls.; double mains, not less than 10 and 12 ins. in diameter, to be laid to connect the works with the present pipe system; 10 hydrants to be placed on these connecting mains; the present pipe system to be extended by 5 miles of 6-in. pipe; total estimated cost, $150,000: the company would enter into a 10 years contract, the city to pay for fire protection and water supply for public buildings, parks and cemeteries, 4½ per cent. per annum upon the value of the present works and the net actual cost of the new works and connecting mains; also the same for the proposed extensions; the works to be completed by Oct. 31, 1888.

Moffet, Hodgkins & Clarke, of Watertown, N. Y., have made a proposition to build a complete system of water-works for fire and domestic purposes, the supply to be drawn from D'Aubigne creek. The distribution system to include not less than 16¾ miles of pipe, 184 double nozzle, non-freezing fire hydrants and 91 valves and gates. There would be a wrought-iron or steel stand-pipe, 35 ft. diameter and 72 ft. high, the thickness ranging from 1-in. at the bottom to ¼ or ⅝-in. at top. The pumping plant at the pump house would comprise 2 separate, compound, duplex, double acting, Worthington engines, with an aggregate daily capacity of 4,000,000 galls. against a pressure equivalent to a head of 200 ft., or to throw 5 fire streams at once not less than 100 ft high, through 100 ft. lengths of 2½-in. hose and 1-in. nozzles. The corporation to pay $7,500 per annum after the acceptance of the works, and $40 per hydrant per annum for hydrants or extensions beyond the 16¾ miles. The agreement to continue for 10 years. The dam would be raised 12 ft.

St. Paul, Minn. The number of miles of water mains, sewers, etc., for the years 1886 and 1887, and also the amount ordered for 1888, is shown in the following table:

	1886.	1837.	1888.
Water main	26.6	36.	15.57
Sewers	5.5	7.63	9.24
Pavement	1.15	5.	5.22
Sidewalks	60.7	49.5	80.80
Curb and gutters	9.5	27.2	14.63
Streets graded	52.5	78.	.....

Irrigation in New Mexico.—The Albuquerque Land & Water Co. will shortly commence work on its great irrigation canal, which will run from the Rio Grande, near Espanola to a point on the same river below Socorro, a distance of 142 miles. There will be storage reservoirs along the route. The canal will be 30 ft. wide at the top, 18 ft. at the bottom and 6 ft. deep. About 1,500,000 of land will be irrigated and reclaimed.

Dover, N. J.—The new water-works were completed and tested last month. The storage reservoir, which has 2 basins, has a capacity of 7,000,000 galls.; there are 3 outlets, in order to facilitate the emptying of the reservoir for repairs, etc. Water is brought to the reservoir from 14 springs on the watershed through 3 miles of terra-cotta pipe. The distribution pipes are from 6 to 12 ins. diameter. The pressure in the business portion of the town ranges from 74 to 80 lbs. ISAAC E. CASSIS was Chief Engineer. PHILLIP J. H. BASSET was Engineer of Construction and will remain as resident superintendent. The works are owned by the Dover Water Co.

Catskill, N. Y.—The Board of Water Commissioners have submitted their report for the year ending May 1, 1887, to the Board of Supervisors of Greene county. The surface of the reservoir has been maintained at an average height of 243 ft. above mean tide and depth of water 16 ft. 8 7-12 ins. During the year 89,263,900 galls. of water were delivered into the reservoir and the average daily consumption was 248,161 galls. There is considerable waste in summer for garden watering, etc., and in winter from letting water run continually from the faucets, the latter in spite of the requirement of the Commissioners that a stop cock to shut off the water and drain the pipes shall be attached to every service pipe. During the year 5,005 ft. of pipe were laid, bringing the distribution system up to 50,026 ft. of 1¼ in. to 12 in. pipe; 8 hydrants and 4 gates were added making totals of 100 and 48. The report contains a financial statement. President, GEO. W. HOLDRIDGE; Secretary, EDWARD ASHLEY; Treasurer, GEO. T. WILLIAMS; Superintendent, FRANK P. SMITH.

Water Waste at Toronto.—The results of the water-works night inspection have been most satisfactory, and the work has resulted in a very large saving of city water by the prevention of willful waste and the detection of leaks. From the 19th October to the 10th of December there were 23,882 places inspected; 1,500 inside leaks or leaks in premises and 170 outside leaks in city mains detected and steps taken to have them repaired; 285 boxes were found to be choked up. The whole city has been covered twice by the inspectors, and they are now going over the city for the third time. Water takers were generally very willing to assist the inspectors in preventing unnecessary waste. In one district recently the inspectors reported 49 taps left running at night.

The Electric Light in New England.—The use of the electric light is becoming more and more general and large plants are continually being put in throughout New England. On Jan. 2 the city of Newport, R. I. was lighted by electricity for the first time. Only 100 lights were in operation, but this is to be the nucleus of a much larger system, if the lights give satisfaction. At Skowhegan, Me., a 1,000-light station has just been established, which will supply all the large buildings, the theatre and the hotels. The dynamos are run by water power, furnished by the Kennebec river. This is the case in most of the New England towns where the electric light is in use, especially in Maine. Saccarappa, Me., has just installed 500 Edison incandescent lights. The Presque Isle Electric Lighting Co. has just put in a plant of 300 lights, and at Lewiston, Me., a 100-light arc American plant is nearly ready. In Claremont, N. H., 600 lights are to be run by a local company. At Hyde Park, Mass., there is under construction a 100-light system of American lights. In Boston 600 lights have been put into J. W. Tuft & Co.'s new building on Portland street, while the Boston Cordage Co.'s works in South Boston have been supplied with 350 lights. 600 lights now illuminate M. M. Arnold's large shoe factory in North Abington, Mass., and the paper mill of F. W. Bird at East Walpole, Mass., has 75 lights. The underwriters approve of electric lighting for factories and mills, and reduce the premiums charged where it is used. It is estimated that at the present time there are between 70,000 and 80,000 electric lights in use in New England.

Contracting.

Pumping Station.—The following proposals for the North Minneapolis Pumping Station were received by A. RINKER, City Engineer, Minneapolis, Minn.: S. C. Cutter, $42,900; L. C. Bisbee, $44,355; Trainor Bros., $49,500. All Minneapolis firms.

Sewers.—The Sewer Commissioners, Fort Smith, Ark., will receive bids till Feb. 7 for the following work: Vitrified, salt-glazed, sewer pipe; 62,800 ft. of 8-in. 2,450 ft. of 10-in., 6,825 ft. of 12-in., 5,775 ft. of 15 in., 6,465 ft. of 18-in., 3,500 ft. of 21-in.; together with Ys, joints, covers, etc.; brick circular sewers, 350 ft. of 24-in. diam., 400 ft. of 28-in., 7,700 ft. of 45-in.; pipe may be used instead of brick; also for 69 flush tanks, 375 manholes and 25 receiving basins. JOHN W. NIER, Kansas City, Mo., is Consulting Engineer.

Water Pipe.—The following proposals were opened Jan. 10 by the Water Commissioners, Merritton, Ont., Canada: Alex. Gartshore, Hamilton, Ont.; pipe, $38.08 per ton of 2,240 lbs.; specials, $2.75 per 100 lbs. St. Lawrence Foundry Co., Toronto, Ont.; pipe, $38.30 per ton of 2,240 lbs.; specials, $3 per 100 lbs. The contract was awarded to Alex. Gartshore.

Water-Works Contracts.—*Woodberry, Md.* The Consumers' Water & Illuminating Co., of Baltimore, has awarded the contract for building the water and gas works to Geo. B. Morton, at about $200,000.

Marion, Va.—The Glamorgan Co., of Lynchburg, Va., has the contract for the new water-works, at about $12,000.

Beaumont, Tex.—Thomas & Gorman, of Dallas and Houston, are the contractors for the works. There will be 2 miles of 4, 6 and 8-in. mains, a stand-pipe 12 ft. diameter and 120 ft. high and a pumping engine with 16-in. cylinder and 8-in. pump.

Piles.—The following proposals for 100 spruce, cypress or white or yellow pine piles have been received by the Docks Commissioners, New York City: A. J. Murray, $13 each; Charles B. Carman, $14; Beard & Kempland, $16. The contract was awarded to A. J. Murray.

Water-Works at Dallas, Tex.—The Water Commissioners, Dallas, Tex., received a large number of proposals for the construction of the new water-works, advertised in ENGINEERING NEWS. For pipe the bidders were, Gloucester Iron Works, Philadelphia, Pa., $53.75 per ton; R. D. Wood & Co., Philadelphia, $36.35; Mellert Foundry & Machine Co., Reading, Pa., $38 per ton.——For valves, etc., Ludlow Valve Co., Troy, N. Y.; W. S. Payne, Fostoria, O.; Eddy Valve Co., Waterford, N. Y.; Galvin Brass & Iron Works, Detroit, Mich.; Chapman Valve Co., Indian Orchard, Mass.; Daniel Kennedy, New York.——The bidders for the reservoir work, etc., who bid in detail prices which are given at length in the Dallas *Morning News*, Jan. 12 and 13, (and may be seen at this office), were as follows: Hetherington & Mason, Dallas; John J. Everson, Akron, O.; Samuel R. Bullock & Co., New York City; W. J. Sherman, Dallas; McRae, Lally & Sons, Detroit, Mich.; Fruin Bambrick Construction Co., St. Louis, Mo.; T. C. Brooks & Co., Jackson, Mich.; F. O. Brown, Fort Worth, Tex.; George M. Figh & Co., Dallas; J. G. Norton, Toledo, O.——Other bidders were, W. E. Keller, Dallas, for stone, Butler & Co., Dallas, for bricks $9.25 per 1,000, Louis Grant, Pottsville, Pa., cement and concrete. American Sewer Pipe Co., Akron, O., for pipe. J. Lang, Dallas, for earth excavation 28.8 cts. per cu. yd. R. C. Story, Fort Worth, Tex., for works complete $180,000 or $189,000 in Dallas 5 per cent. bonds; $37,000 to be deducted if only one reservoir is built.——The bids for pumping engines are given elsewhere.——The Water Commissioners will report to the City Council on Jan. 21.

Boylston Street Bridge.—JOHN W. MCDONALD, Superintendent of Streets, City Hall, Boston, Mass., will receive bids till Jan. 28 for an iron and steel bridge over the Boston & Albany R. R. It will be a through, skew bridge, 216 ft. span, 80 ft. wide, 2 trusses. Plans and specifications at the office of the City Engineer.

The Marion Steam Shovel Co., of Marion, O., manufacturers of Barnhart's steam shovel and wrecking car, ballast unloaders, railroad ditchers, dredgers, etc., has issued a new illustratedcatalogue, giving large cuts, descriptions, testimonials and prices of their shovels, ditchers, etc. There is a table of the styles, capacity and dimensions of the machines manufactured. The catalogue is handsomely got up and cannot fail to interest railroad builders and all parties having use for such machines.

Granite Paving Blocks.—The following proposals for Maine granite blocks, 3½ to 4 ins. wide, 6 to 8 ins. long and 7½ to 8 ins. deep, have been received by the Committee on Roads and Bridges, Cambridge, Mass.: S. J. Sewall, Everett, Mass., $47 for 1,000; James J. Vernon, Lanesville, Mass., $47.50; John J. Horgan, Cambridge, Mass., $49; Lanesville Granite Co., Lanesville, Mass., $52; S. & R. J. Lombard, Boston, Mass., $56. The contract was awarded to S. J. Sewall.

The Pittsburg Boiler Scale Resolvent has its basis in a particularly greasy petroleum, specially selected for the purpose, which has a vaporizing point of nearly 600 degrees Fahrenheit, and is wholly free from tar or wax. It acts by giving a slightly greasy coating to the inside of the boiler, like the touch of a sweaty hand on a window pane, but sufficient to prevent adhesion. It gives to the water a greasy character so slight as to be scarcely perceptible, but sufficient to prevent the minerals contained therein from clinging together, and crystallizing. It also prevents corrosion of the boiler from acids contained in the water. The cost will not exceed 10 cts. per week for a 50 horse-power boiler. Send for circular containing further information, and testimonials from the largest steam users in America, to the Pittsburg Boiler Scale Resolvent Co., Chemists and Engineers, Pittsburg, Pa.

Pipe, Hydrants, Etc.—The following proposals were opened Jan. 11 by CHAUNCEY STRONG, City Clerk, Kalamazoo, Mich.: *Pipe and Specials.* Addyston Pipe & Steel Co., Cincinnati, O.; pipe, all sizes, $26.45 per ton; special castings 2⅞ cts. per lb. New Philadelphia Pipe Works, New Philadelphia, O., $29.50; 2¼ cts. Shickle Harrison & Howard Iron Co., St. Louis, Mo., $29.50; 2¼ cts. Lake Shore Foundry, Cleveland, O., $26.85; 2¼ cts. Detroit Pipe & Foundry Co., Detroit, Mich., 20 and 24-in. pipe, $27.14; 6 and 8-in. pipe, $27.43. Mellert Foundry & Machine Co., Reading, Pa., 20 and 24-in., $32; 6 and 8-in., $33. Camden Iron Works, Camden, N. J., 20 and 24-in., $29.25; 8-in., $30.45; 6-in., $30.95; specials, 3 cts. Warren Foundry & Machine Co., New York, 24-in., $30.45; 20-in., $31.50; 6 and 8-in., $33.50. Dennis Long & Co., Louisville, Ky., 24 and 20-in., $27; 6 and 8-in., $27.75; specials, 2½ cts. The Addyston Pipe & Steel Co. was the lowest bidder.

Valves & Hydrants.—The bidders were as follows: Crane Bros. Mfg. Co., Chicago; Mellert Foundry & Machine Co., Reading, Pa.; Florence Iron Works, Florence, N. J.; James B. Clow & Co., Chicago; Galvin Brass & Iron Works, Detroit, Mich.; I. S. Cassin & Co., Philadelphia, Pa.; Jonson Foundry & Machine Co., New York; Peet Valve Co., Boston, Mass.; Daniel Kennedy, New York; James Flower & Bros., Detroit, Mich.; Walter S. Payne & Co., Fostoria, O.; Chapman Valve Mfg. Co., Indian Orchard, Mass.; Whittier Machine Co., Boston, Mass.; National Tube Works Co., Chicago; Richard Beaumont, Kankakee, Ill.; Bourbon Copper & Brass Works, Cincinnati, O. The lowest bid was from Crane Bros Mfg. Co.

Water Pipe.—The following proposals for 1,051 ft. of 6 in. and 1,051 ft. of 8 in. pipe were received Jan. 10 by the Board of Public Works and Affairs, Nashville, Tenn.; South Pittsburg Pipe Works, South Pittsburg, Tenn., $30.45 per ton of 2,000 lbs.; H. S. Jackson & Co., Nashville, $30.50; Dennis Long & Co., Louisville, Ky., $31; Shickle, Harrison, & Howard, St. Louis, Mo., $32.40; R. D. Wood & Co., Philadelphia, $32.90. The contract was awarded to the South Pittsburg Pipe Works. F. E. KUHN is Secretary to the board.

The Chalmers-Spence Co., 419 Eighth street, New York, and at Boston, Providence, Philadelphia, Pittsburg and Chicago, manufacturers of asbestos goods, asbestos cement, etc., have issued an illustrated catalogue. The catalogue contains tables of the prices of coverings for different sizes of pipes and directions for applying the coverings. Also particulars respecting the patent "fire felt" a sectional covering for steam boilers.

Pumping Engines.—The following proposals were opened Jan. 11, by the Water Commissioners, Dallas, Tex.: J. D. Cook, Toledo, O., Consulting Engineer: Holly Manufacturing Co., Lockport, N. Y.: No. 1, $25,500 including foundation; horizontal and vertical pumps, steam cylinders, 20 and 36 ins., 4 single acting pumps 26 in. diameter; 48 in. stroke; duty 80,000,000.—No. 2; $32,000; vertical steam cylinders, 34 and 48 ins., 2 single acting pumps, 40 ins.; stroke 36 in.; duty 95,000,000.—No. 3; $23,000; Gaskill horizontal engine; cylinders 36 and 18 ins., pumps 28 ins.; stroke 32 ins.; duty 95,000,000.—No. 4: Gaskill duplex direct acting, $17,000; cylinders, 18 and 36 ins., pump 28 ins.; stroke 24 ins.; duty 60,000,000.

Geo. F. Blake M'f'g Co., New York: compound, duplex, horizontal, $29,000, cylinders, 18 and 34 ins.; pumps, 22 ins.; stroke, 36 ins; duty 85,000,000 to 95,000,000.

Knowles Steam Pump Works, New York: compound duplex horizontal, $26,500; cylinders 15 and 28 ins.; pump 36 ins.; stroke, 48 ins.; duty 65,000,000.

H. R. Worthington, New York: No. 1, $18,000; compound, duplex, direct action; cylinders 28 and 36 ins.; pump, 31 ins., stroke, 24 ins.; duty 65,000,000.—No. 2, $22,400; similar type, cylinders, 26½ and 21 ins.; pumps, 31 ins.; stroke, 36 ins., duty 65,000,000.—No. 3, $24,000; 2 engines; cylinders, 14 and 25 ins.; pumps, 21 ins., stroke, 24 ins.; duty 65,000,000, or 60,000,000 with outside packed plungers.—No. 4, $33,400. cylinders, 21 and 42 ins.; pumps, 30 ins.; stroke, 36 ins.; duty 90,000,000.—No. 5, $18,000; same as No. 3.

E. P. Allis & Co., Milwaukee, Wis.: No. 1, $21,100; without foundations; condensing engine; cylinder, 26 ins.; pump, 28¾ ins.; stroke, 48 ins.; duty, 75,000,000.—No. 2, $24,750 without foundation; compound, condensing; cylinders, 19 and 36 ins.; pump, 28¾ ins.; duty, 95,000,000.

Deane Steam Pump Co., Holyoke, Mass.: compound condensing engine, $29,335 with foundations; cylinders, 16 and 30 ins.; pump 30 ins.; stroke, 48 ins.; duty 50,000,000. Deduct for 1 ft. less stroke, $2 500.

Proposals Open.

Sewer Pipe.—Vitrified pipe. W. E. CUTSHAW, City Engineer, Richmond, Va.

Iron Bridge.—At Boylston street, over the Boston & Albany R. R. Span 216 ft.; width 80 ft. (See first advertising page). JOHN W. MCDONALD, Superintendent of Streets, City Hall, Boston, Mass. Jan. 28.

Water-Works.—Cast-iron pipe, 12,100 ft. of 4, 6 and 8-in.; pumping engine of 1,000,000 galls. capacity; buildings, etc. Consulting Engineers, LOWETH & CURTIS, St. Paul, Minn. J. H. JEFFERS, Chairman, Water-Works Committee, Cedar Falls, Ia. Jan. 31.

Pump, Etc.—Steam pump, boiler, and smokestack, for the water-works. F. F. PLANTZ, Village Clerk, Morrisburg, Ont., Canada. Feb. 6.

Sewers.—Pipe and brick sewers, manholes, flush tanks, basins, etc. Engineer, JOHN W. NIER, Kansas City, Mo. E. MCKENNA, Chairman, Sewer Commissioners, Fort Smith, Ark. Feb. 7.

Water-Works.—Complete system; to be built during the year. Bids based upon system, plans and specifications proposed by bidders, without charge or expense to the city. C. R. DAVIS, City Clerk, St. Peter, Minn. March 1.

Sewers.—Plans and specifications on file. HARVEY C. LOWRIE, City Engineer, Denver, Col. March 19.

RAILROADS

East of Chicago.

Existing Roads.

Temiscouata.—The completion of the Temiscouata railway on January 8th inst. (when the last spike was driven) opens up another route between the Maratime Proyinces and the west. The first train from Rivere du Loup to Edmundston passing over the entire road (81 miles) on the 10th inst.

This railway was projected shortly after the signing of the Ashburton treaty in 1842, and the first survey was made in 1846.

After the union of the Provinces in 1867, when the route for an Intercolonial railway was being discussed, it was again prominently before the public, and was known as the "Frontier Line," but for military reasons it was abandoned. Since then several attempts to revive the scheme proved unsuccessful, and it was not till 1886 that any practical advance was made, when the then charter holders succeeded in completing negotiations with the well known contractor Mr. JOHN J. MCDONALD and his partner Mr. BOSWELL for the construction of the line.

Surveys were immediately commenced and by the close of 1886, over 60 miles was ready for construction. Severe weather delayed the work, so that no more than 5 per cent. was done on June 1, 1887. Since then the work has been vigorously pushed by the General Manager Mr. J. J. MCDONALD and the Chief Engineer Mr. R. ADAMS DAVY.

The greater part of the country through which the route passes is extremely rugged, the line having to cross the divide between the water-sheds of the St. Lawrence and St. John rivers at an elevation of 1,200 ft. above sea level.

The road connects with the Intercolonial railway at Rivere du Loup and with the New Brunswick railway at Edmundston, N. B. running entirely on Canadian territority, forming another important through route, shortening the distance between Montreal and St. John's, N. B. by 160 miles.

The inhabitants of the fertile valley of the St. John river have long suffered from the want of Western railway connection which this road will afford, and it will no doubt prove of inestimable value not only to Canadians but also to the Americans residing on the opposite bank of the river.

Somerset.—E. S. GRAVES, engineer of the northern extension of this Maine road writes: "Work is progressing and will be pushed through the winter. It is our intention to reach Carratunk Falls, eight miles distant, in the early summer. The bridge across the Carabasett at North Anson will undoubtedly be put on before spring; the masonry is nearly completed."

Pennsylvania.—A report from Pittsburg states that the company has decided upon plans for an elevated road to do away with the present grade crossings on their line from the Pittsburg union depot to the Allegheny City station, about two miles. Another project is on foot at Toledo for a tunnel to connect the North Toledo yards with the new belt railway.

Baltimore & Ohio.—There has been quite a serious fight over the proposal to issue $5,000,000 of additional stock. The directors representing the stock held by the city of Baltimore and State of Maryland strongly opposed the issue, and according to present reports have defeated the watering scheme. It is reported that a 4 mile extension is to be built at Newark, O., to connect with the Toledo & Ohio Central road.

New York, Pennsylvania & Ohio.—There is every prospect that the New Lisbon, East Liverpool & Southern road will be built by this company the coming season. The Pittsburg, Marion & Chicago company seem to have abandoned their rival project.

Grand Trunk.—It is stated that the St. Clair tunnel project has by no means been given up as has been reported, but will be carried through at an early date.

Canadian Pacific.—Newspaper reports state that if the Grand Trunk succeeds in its attempt to secure control of the Northern & Northwestern system, its rival will build a line from Claremont through Uxbridge, Brock, Thora, Mara and Rama to a junction with the Northern, a distance of about 100 miles. A new line would also be built from Toronto to the Niagara river.

New Projects and Surveys.

Rochester & Honeoye Valley.—This company has been organized at Rochester, N. Y., to build a railroad from Rochester to Honeoye Falls, a distance of about 12 miles. ALLEN A. BEACH is Vice President; HENRY D. MCNAUGTON, Treasurer; GEO. MOSS, Secretary, and A. G. CHILDS, Chief Engineer. Surveys are reported already in progress.

Kingston, Smith's Falls & Ottawa.—The board of trade, of Kingston and prominent business men of Smith's Falls, are interesting themselves in the proposed enterprise, and it seems probable that work will be undertaken at an early date. It is thought that with a government subsidy enough capital can be secured in Kingston, Smith's Falls and the towns along the route to give the enterprise good financial standing and ensure the favorable sale of bonds.

Schenectady & Ogdensburgh.—Attention has been drawn to this company by a bill now before the New York legislature relating to certain special privileges to the corporation at its St. Lawrence terminus. The company is said to be about placing $5,000,000 of bonds in preparation for actual work in the spring. The mortgage is executed to the American Loan and Trust Co., of this city.

Manchester & Portland.—A survey is to be made at once of the proposed railroad between these Connecticut towns. Prominent business men of Manchester, are at the head of the enterprise.

Raritan River.—This is the new title of the proposed line from South Amboy to Bound Brook, New Jersey, a distance of 12 miles. The officers are WM. A. TAYLOR, of New York City, President, and E. W. HARRISON, Fuller Building, Jersey City, Chief Engineer. Contract for building has been let to John Batman and graders are already at work.

Buffalo & Williamsville.—The annual meeting of his company was held Jan. 13. N. P. STANTON, of New York; J. S. BUELL, WM. H. WATSON, B. J. TILLMAN, and others, of Buffalo, were chosen directors. The company wishes to enlist the aid of capitalists in the enterprise, and if successful the line will be built this year.

Bay City & Battle Creek.—A company to build a railway between these Michigan towns is to be organized by the Bay City Business Mens' Association. A considerable amount of stock has already been taken by the towns along the route.

Hudson Suspension Bridge & New England.—This company which proposes to bridge the Hudson at Peekskill has voted to issue $10,000,000 of bonds. Gen. E. W. SERRELL of this city, is interested in the enterprise.

SOUTHERN.

Existing Roads.

Louisville & Nashville.—Grading is reported to have commenced on the thirty mile gap in the Selma &

Gulf division from Pine Apple to Repton, Ala.——A movement is on foot to extend the Indiana, Alabama & Texas road from Clarksville, Tenn., south to Dickson on the Nashville, Chattanooga & St. Louis, about 30 miles, F. P. GRACEY, of Clarksville and others interested in mineral lands along the proposed route are pushing the enterprise and hope to induce the company to build the extension next season.

Louisville Southern.—It is stated that JOHN MCLEOD, Chief Engineer, will be the General Manager of this road when it is opened for business. Col. BENNETT H. YOUNG, who has been the chief worker in building the road, will succeed J. W. STINE as President. Bonds have been sold sufficient to complete the line and work will be pushed through at an early date. The rolling stock has already been purchased from the Baldwin Locomotive Works and the Jackson & Sharp Car Co.

Kentucky & South Atlantic.—A railroad meeting was held at Mt. Sterling, Ky., Jan. 5, looking to the extension of this road and the building of the projected Charleston, Kentucky & Western. The meeting passed resolutions requesting the legislature to amend the charters of these corporations so that the county of Montgomery and city of Mt. Sterling can subscribe not to exceed $150,000 to each corporation.

Atlanta & Florida.—The 32 miles of this road from Atlanta to Woolseyville were placed in operation Jan. 16. Work is rapidly progressing along the line and it is expected to reach Williamson by Feb. 20, Zebulon by March 10, Culloden by May 1, and Fort Valley, 100 miles from Atlanta by June 1.

New Projects and Surveys.

Georgia Terminal.—A charter has been issued to ALFRED SULLY, President of the Richmond & West Point Terminal Co., and other officers of this company, the East Tennessee, Virginia & Georgia and the Central R. R., of Georgia, to build a belt railroad around Atlanta and a union passenger depot.

Great Southern.—A bill is before the Virginia legislature to charter a railroad to extend from Norfolk to Bristol, Tenn.

Roanoke & Southern.—Work is soon to begin on the first division of this road from Winston, N. C., to Martinsville, Va. The company is considering proposals from contractors.

Isbell & Iron Mountain.—This line is reported under survey from Isbell, Ala., to Aberdeen, Miss., 75 miles, and it is reported the company intends to let contracts soon. C. H. CASTLE, Quincy Ill., is President, and W. C. VANCE, Russelville, Ala., is Secretary.

Pleasant Hill & Winterville.—Incorporated by JAS. M. SMITH and others, of Winterville, Ga., to build a branch to the Georgia railroad, 10 miles in length.

Macon Alabama.

TALBOTTON, GA., Jan. 15, 1888.

EDITOR ENGINEERING NEWS:

The Macon & Alabama railway has been surveyed from Macon, Ga., to Waverly Hall on the Georgia Midland & Gulf road, a distance of 98 miles; and will extend from that point to Opelika, Ala., making an air line of 94 miles. Capital for building has been secured conditioned upon raising subsides and local aid to the amount of $2,000 per mile, a good share of which has been obtained. M. NUSSBAUM of Macon is President of the company and Mr. WELLS is Chief Engineer.

J. B. GORMAN.

Mobile, Hattiesburg & Jackson.—Chief Engineer S. D. BROWN of Mobile will begin the surveys on this line very soon.

THE NORTHWEST.

Existing Roads.

Chicago & Northwestern.—The following is a statement of the mileage of this system as it stood on Dec. 31, 1887, for which we are indebted to the courtesy of Assistant Engineer, L. H. EVANS.

Division.	*Miles.*
Wisconsin	549.16
Galena	397.76
Iowa	618.43
Northern Iowa	545.91
Madison	502.31
Peninsula	414.75
Winona & St. Peter	448.41
Dakota Central	723.93
Total	4,209.74
Fremont, Elkhorn & Missouri Valley System	1,152.32
Sioux City & Pacific	76.00
Chicago, St. Paul, Minneapolis & Omaha system	1,399.47
Grand total	6,837.53

St. Paul & Duluth.—The new short line between Duluth and Thomson, 15¼ miles has been opened for business.——The company's managers are said to be still considering the proposed extension from St. Paul direct to Omaha, and examining the reports of the preliminary surveys which have been made. A glance at the map shows that a direct line may be built between the points named without closely paralleling any existing lines. It is evident that the company's managers would not have gone to the expense of preliminary surveys without some definite plans in relation to the extension, and if the present market for bonds keeps up, it is quite likely that the work will be undertaken the coming season.

Duluth, South Shore & Atlantic.—A bill has been introduced in Congress granting permission for a bridge across the St. Louis river from Rice's Point to Connor's Point. This indicates a probable entrance to Duluth.

New Projects and Surveys.

Ortonville & Southern.—Incorporated at Ortonville, Minn., to build a railroad from Ortonville *via* Pipestone City to the west line of the State.

Omaha & Mexican Air Line.

HARLAN SHELBY CO., IA., Jan. 12, 1888.

EDITORS ENGINEERING NEWS:

The charter for our company has just been issued. The intended route is from Omaha, Neb., southwest through the countries of Douglas, Sarpy, Saunders, Lancaster, Seward, Saline, Thayer, Fillmore and Nuckolls in Nebraska; Jewell, Smith, Phillips, Rooks, Graham, Trego, Lane, Gore, Scott, Wichita, and Hamilton in Kansas; Burt and Las Animas in Colorado; Colfax, Mora, San Miguel, Bernalillo, Valentine, Lincoln and Dona Ana in New Mexico; and El Paso in Texas, to the city of El Paso; thence to the city of Mexico, Mexico. The line will be put under survey the coming spring. Right of way is being secured. The enterprise is projected principally in the interest of Omaha.

W. F. CLEVELAND, President.

A rough measurement of the above "air line" determines its length as something over 2,000 miles. Comments seem quite unnecessary.

Chicago, Paducah & New Orleans.—The projectors of this road are working for local aid from the towns along its route.

THE SOUTHWEST.

Existing Roads.

St. Louis & San Francisco.—A survey is reported in progress from Monett, Mo., toward Kansas City.——The proposed extension of the Paris & Great Northern road in Texas is being actively contended for by Dallas Denison and Sherman.

Kansas City & Southern.—A proposed change in the located line between Kansas City & Harrisonville is under consideration. The line is graded within 7 miles of Kansas City, and tracklaying will begin as soon as weather permits. $1,000,000 of bonds will be issued July 1, and will be taken by JOHN I. BLAIR, of New Jersey, the principal backer of the enterprise.

Atchison, Topeka & Santa Fé.—San Angelo, Tex., is trying to raise funds for a bonus to induce the company to build from Ballinger to San Angelo, about 40 miles.——It is reported that the company is accumulating material at Panhandle City, the present terminus of the Kiowa extension and will soon push work on its line to Las Vegas, N. M.

New York stock brokers have been fond of predicting dire financial calamities to the company as a result of its wholesale extension policy: but these bear rumors got a very black eye on Jan. 16, when it was announced that the company has just marketed $6,000,000 of bonds to a syndicate representing, Kidder, Peabody & Co., Irving A. Evans & Co., Lee Higginson & Co., and other of the strongest banking houses of Boston and New York.

Des Moines, Osceola & Southern.—E. R. MASON, receiver, has turned over the property to M. V. B. EDGERLY, of Springfield, Mass., representing the bondholders' purchasing committee. James Donohue, of Des Moines, Ia., has been appointed superintendent by Mr. EDGERLY. The name of the new company will be Des Moines & Kansas City, and the extension from Cainsville, Mo., will probably be undertaken the coming season.

San Antonio & Aransas Pass.—The Galveston extension will probably be undertaken soon. The company is about to send out parties to make preliminary surveys in the Louisiana parishes of Calcasieu, Vernon, Rapides, Grant, Catahoula and Concordia. The most eastern point of the Aransas Pass system at present is at least 150 miles from Louisiana. If the company is to begin work on lines so far to the east, there may be some truth to the report that the Santa Fé has secured a large interest in this corporation.

Chicago, Rock Island & Pacific.—A dispatch from Wichita Falls, Tex., dated Jan. 15, states that the Rock Island surveying corps in charge of E. L. PRESTON has reached that point on the locating survey of the extension from Caldwell, Kan.

"From Wichita Falls the road will be built to Jacksborough, where it will consolidate with the Fort Worth and Western and thus gain easy entrance to Fort Worth. The Rock Island will cross the Texas Pacific at Cisco, the same point where the Texas Central crosses. The western route will traverse the entire Pan Handle and strike the Texas Pacific at Odessa, 280 miles east of El Paso. Odessa and Cisco are 214 miles apart. From these points both lines converge south and southeast, meeting at San Antonio, where it will absorb the San Antonio and Aransas Pass line, tapping the Gulf of Mexico at Aransas and Corpus Christi."

If the sanguine stories which originate at Wichita Falls are to be believed, the Rock Island system will build itself into a Receiver's hands this year. We do not apprehend however that this will be the case.

Chicago, Milwaukee & St. Paul.—Gen. Agent J. H. HILAND is reported as saying that the company will build a branch from its Kansas City extension to St. Joseph for a satisfactory subsidy.

New Projects and Surveys.

Denison & Sherman.—Incorporated to build a railroad from Denison *via* Sherman to Abilene, Tex., by J. M. FORD of Kansas City, EDWARD PERRY of Denison and others.

Wichita & Winfield.—J. R. TAYLOR of Wichita, J. MANSUR of Winfield and others, are to build a railroad from Wichita to Winfield, Kan., 47 miles. The Missouri Pacific Company guarantees the bonds of the road and agrees to take and operate each 10 miles as completed.

Paragould & Buffalo Island.

PARAGOULD, ARK., Jan. 3, 1888.

EDITOR ENGINEERING NEWS:

Our road is to run from Paragould, Ark., to Cotton Plant, Mo., about 23 miles. Capital for building has been secured by subscription, and surveys are partly made. Our steel is purchased on time payments from the St. Louis, Arkansas & Texas company. Earthwork on the line is light, and grades are easy. The road is built to develop the lumber and cotton interests; HENRY WRAPE is President and JNO. B. BOYKIN is Chief Engineer. A. BERTIG, *Treasurer.*

Omaha, Lincoln & Southwestern.

HARTLAND, KAN., Jan. 10, 1888.

EDITOR ENGINEERING NEWS:

Our proposed line of road will extend from Omaha, Neb., *via* Lincoln, Neb., Belvidere, Neb., and Wakena, Kan., to Garden City, and from there southwest to make the total length of the line about 940 miles. Work is rather light; the maximum grade is 39.6 ft. The road bed is completed from Wakena to Garden City and locating surveys from Wakena north will begin Apr. 1. Grading is being done by private subscriptions, and the road is to be independent of existing lines. FRED de FUNIAK of Louisville, Ky., is Chief Engineer.

L. S. JONES, *President.*

Chicago, Hannibal & Springfield.—The proposed combination of this company with the Central Missouri to build a common line through Ralls county has fallen through. The officers of the company are trying to secure heavy local aid at Hannibal, Versailles, Mexico and other towns along the route. Surveyors are at work on the line.

Chicago, Kansas & Southwestern.—

MARYSVILLE, MO., Jan. 9, 1888.

EDITOR ENGINEERING NEWS:

The Chicago, Kansas & Southwestern is a railroad projected to run from Parnell City, Mo., on the line of the new Chicago, St. Paul & Kansas City, to the Missouri River bridge at Rulo, Neb., and thence southwest; a distance of 240 miles in the State of Kansas, 10 miles in Nebraska and 60 miles in Missouri. The portion west of the Missouri river has been surveyed. The portion in Missouri will probably be surveyed during the coming spring or summer. The practicability of the route of this road is conceded and also its value as a feeder to the Chicago, St. Paul & Kansas City road, now nearly completed to St. Joseph, Mo. The conviction is strong that the road will be built this coming season. JOSEPH JACKSON of Maryville is President of the line in Missouri. For information in regard to that portion of the line west of the Missouri river I refer you to GEO. BOON of Hiawatha, Kan., Secretary of the Kansas Co.

W. SISSON.

Missouri Midland R. R. & Bridge Co.—

BRUNSWICK, MO., Jan. 11, 1888.

EDITOR ENGINEERING NEWS;

The proposed route of our road is from Chillicothe to Sedalia *via* Dewitt and Marshall, about 125 miles. The Missouri river will be crossed at De Witt. Right of way is being secured and surveys will probably begin in May.

D. C. BASEY, *President.*

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Northern Pacific.—Grading and bridging are about completed on the Rocky Fork & Cooke City line from the junction near Laurel to Red Lake, Montana, and 20 miles more is to be put under contract at once. G. A. KNOWLTON is Chief Engineer of the line.

Southern Pacific.—A survey is to be made at once from Madison in the Capay valley up the Cache Creek valley into Lake county, Cal.

New Projects and Surveys.

Mendocino County.—WELLS & RUSSELL of San Francisco, Cal., propose to build a railroad from Cuffey's Cove to Point Arena, on the coast about 100 miles north of San Francisco, about 20 miles, to develop large timber tracts.

Mazatlan, Culiican & Coast.—This is the name of the proposed Mexican railroad for which a concession has been secured by WM. H. MCWOOD on behalf of a syndicate of San Francisco capitalists. A meeting of the incorporators of the enterprise was held recently to hear Mr. McWood's report. It was stated that the surveys had been completed from Mazatlan on the Gulf of California to Sinaloa and from San Marcial to Hermosillo on the Sonora Railroad. The Sonora company will offer large inducements for the line to terminate here, so that the traffic would pass over their line north to the United States. By the concession, however, the company has the right to continue on northwest 400 miles to connect with a branch from the Southern Pacific. If this is done the total length of the main line will be 1200 miles. Col. EDMOND GREEN of San Francisco is President of the company.